



DelDOT Contract No. T201609002

Agreement 1769 – Project Development and Design Services

I-95 and SR 896 Interchange



Preliminary Stormwater Management Report/ Concurrence Meeting No. 1

February 2020

Century Engineering, Inc.
550 Bay Road
Dover, DE 19901
(302) 734-9188

SWM Designers: Emily A. Price, E.I.
Andrew T. Ford, P.E.

Table of Contents

1.0 Project Location and Scope	2
2.0 Existing Site Description	2
2.1 Points of Analysis (POA) and Line of Analysis (LOA).....	3
2.1.1 POA 1.....	3
2.1.2 POA 2.....	3
2.1.3 POA 3.....	3
2.1.4 POA 4.....	4
2.1.5 LOA 5	4
2.1.6 POA 6.....	4
2.1.7 POA 7.....	4
2.1.8 POA 8.....	4
2.1.9 POA 9.....	4
2.1.10 POA 10.....	5
2.1.11 POA 11.....	5
2.1.12 POA 12	5
2.2 Existing Stormwater Management Facilities.....	5
2.2.1 BMP No. 525.....	5
2.2.2 BMP No. 166.....	5
2.2.3 BMP No. 164.....	6
2.2.4 BMP No. 165.....	6
3.0 Stormwater Management Approach	6
3.1 Resource Protection Event (RPv).....	6
3.1.1 BMP No. 1XX.....	6
3.1.2 BMP No. 2XX.....	7
3.1.3 BMP No. 3XX.....	7
3.1.4 BMP No. 4XX.....	7
3.2 Conveyance Event (Cv) and Flooding Event (Fv)	7
4.0 Summary.....	7

Appendices

- A. Project Location Map
- B. Project Background Information
- C. Point of Analysis Location Map
- D. Project Level DURMM
- E. BMP No. 1XX
- F. BMP No. 2XX
- G. BMP No. 3XX
- H. BMP No. 4XX

1.0 Project Location and Scope

DelDOT Contract No. T201609002, I-95 and SR 896 Interchange, involves construction plan development for the proposed improvements to the existing interchange. The project area extends from Old Baltimore Pike to Welsh Tract Road along SR 896 and from the I-95 toll plaza to 2,500-ft north of SR 72 along I-95. The project is located south of the city limits of Newark, New Castle County, Delaware. A project location map is in Appendix A.

The purpose of the project is to reduce traffic congestion during peak hours and decrease traffic accidents during different times of the day, which has gradually become worse over many years as traffic volumes have increased. The proposed improvements involve widening and partial roadway reconstruction of the I-95 and SR 896 interchange which includes ramp realignments, the addition of a shared use path, open and closed drainage system upgrades, stormwater management, and new bridges over the Christina River. The interchange design avoids disturbing the closely adjoining natural and historic resources while improving safety and alleviating traffic congestion.

The proposed improvements will result in a net increase in impervious area within the project limits. Existing hydrologic drainage patterns will be maintained where runoff from the project limits leaves DelDOT's Right-of-Way. In addition, the drainage improvements will be designed to safely convey the required design storm events, prevent inlet surcharge, and maintain acceptable spread widths within the project limits. Finally, four best management practices (BMPs) are proposed to provide stormwater management.

2.0 Existing Site Description

The project is located along the Christina River riparian corridor, which is part of the Christina River sub-watershed and ultimately discharges into the Delaware Bay. The Christina River is considered non-tidal upstream of the dam at Smalley's Pond. The existing land use is consistent with the 2017 Delaware Land Use/Land Cover map, which indicates the project and areas within its vicinity are comprised of retail/sales/wholesale/professional services, waterways/streams/canals, highways/roads/access roads/freeways/interstates, and deciduous forest (within Right-of-Way).

The site is comprised of multiple soils which are classified as Hydrologic Soil Group (HSG) Types A through D. The table below summarizes the soil names and types. The project background information is in Appendix B.

Soil Unit Symbol	Soil Unit Name	HSG Type
Hw	Hatboro-Codorus complex, 0-3 % slopes, frequently flooded	B/D*
KpA	Keyport silt loam, 0-2% slopes	D
KpB	Keyport silt loam, 2-5% slopes	D
MkB	Matapeake silt loam, 2-5% percent slopes	C
MtaB	Mattapex silt loam, 2-5% slopes, northern coastal plain	C
MzB	Mount Lucas silt loam, 3-8% slopes	C/D*
MzuB	Mount Lucas-Urban land complex, 0-8% slopes	C/D*
NtC	Neshaminy silt loam, 8-15% slopes	B
NvD	Neshaminy-Montalto silt loams, 15-25% slopes, very stony	B
NxB	Neshaminy-Urban land complex, 0-8% slopes	B
Up	Urban land	D**
VoB	Urban land-Othello complex, 0-5% slopes	D**
WaB	Watchung silt loam, 3-8% slopes	C/D

*For soils with a dual classification, HSG Type D was selected for all related computations.

**No classification provided, so HSG Type D was selected for all related computations.

Soil Classification Summary Table

2.1 Points of Analysis (POA) and Line of Analysis (LOA)

All stormwater runoff from the site drains to 11 POAs and one LOA through a combination of open and closed drainage systems that discharge directly or ultimately discharge to the Christina River. Overall, the site has no known or observed major flooding areas within the limit of construction. Per email conversation with Canal District Maintenance and Operations, the only known issue is at the northwest corner of Old Baltimore Pike and SR 896 where the ditch and storm drain occasionally get blocked by debris, which is just outside the project limits. The POAs are described in more detail below and a POA location map is in Appendix C.

2.1.1 POA 1

POA 1 is located within an existing ditch where runoff leaves the Right-of-Way near station 406+25 Lt along SB I-95. The POA receives runoff from the travel lanes and shoulder of I-95. From the POA, the existing ditch connects to a larger existing conveyance channel which flows northeast before discharging directly into the Christina River and ultimately, the Delaware Bay.

2.1.2 POA 2

POA 2 is located within an existing ditch where runoff leaves the Right-of-Way near station 410+25 Lt along SB I-95. The POA receives runoff from the travel lanes and shoulder of I-95. From the POA, the existing ditch connects to a larger existing conveyance channel which flows northeast before discharging directly into the Christina River and ultimately, the Delaware Bay.

2.1.3 POA 3

POA 3 is located at the outfall of an existing 42x27-inch HE-RCP culvert under I-95 where runoff leaves the Right-of-Way near station 412+50 Lt along SB I-95. The POA receives runoff primarily from the forested area located adjacent to NB I-95 at the southwest quadrant of the interchange and from the travel lanes and shoulder of I-95. From the POA, an existing ditch connects to a larger existing conveyance channel which flows northeast before discharging directly into the Christina River and ultimately, the Delaware Bay.

2.1.4 POA 4

POA 4 is located at the outfall of an existing 24-inch RCP culvert under I-95 where runoff leaves the Right-of-Way near station 419+25 Lt along SB I-95. The POA receives runoff primarily from the forested area located adjacent to NB I-95 at the southwest quadrant of the interchange and from the travel lanes and shoulder of I-95. From the POA, an existing ditch connects to a larger existing conveyance channel which flows northeast before discharging directly into the Christina River and ultimately, the Delaware Bay.

2.1.5 LOA 5

LOA 5 is located along the banks on both sides of the Christina River where it meanders through the project under SR 896 and I-95, specifically, bridges 1-649A, 1-649, 1-704, and 1-705. The LOA receives runoff from multiple discharge points consisting of ditches and culverts that drain directly into the river. The river flows generally in a southeasterly direction until it reaches the Delaware Bay.

2.1.6 POA 6

POA 6 is located at the mouth of an existing channel at the southeast quadrant of the interchange near station 337+75 Rt. The POA receives runoff from the outlet of existing BMP No. 166, which manages flows intercepted by a closed storm drain system along NB SR 896. The receiving channel is approximately 4.5-feet wide with shallow side slopes and is heavily vegetated. From the POA, runoff is conveyed south through the channel and discharges into the Christina River, immediately downstream of an existing dam and then flows in a southeasterly direction until it reaches the Delaware Bay.

2.1.7 POA 7

POA 7 is located at the outfall of an existing 36-inch RCP culvert under SR 896 near station 720+60 Rt. The POA receives runoff from both NB and SB SR 896 and the forested area on the west side of SR 896. The POA receives runoff primarily from a closed storm drain system on SR 896 while a smaller portion of runoff is received from an existing roadside swale along NB SR 896. From the POA, runoff is conveyed through an existing V-shaped ditch which flows east before directly discharging into the Christina River downstream of an existing dam and ultimately, the Delaware Bay.

2.1.8 POA 8

POA 8 is located at the outfall of an existing 42-inch RCP culvert under SR 896 near station 704+75 Rt. The POA receives runoff from the forested area on the west side of SR 896 and from adjacent roadside swales along NB SR 896. From the POA, runoff is conveyed through an existing V-shaped ditch which flows east before discharging into the Christina River downstream of an existing dam and ultimately, the Delaware Bay.

2.1.9 POA 9

POA 9 is located at the outfall of an existing 54-inch RCP culvert under Old Baltimore Pike near station 324+50 Rt. The POA receives runoff from the existing forested area and a private stormwater management facility on the west side of SR 896 along with an open drainage channel that runs parallel to SB SR 896. From the POA, runoff is conveyed through a variable 2 to 10-foot wide channel which flows east and then northeast before discharging into the Christina River downstream of an existing dam and ultimately, the Delaware Bay.

2.1.10 POA 10

POA 10 is located at the outfall of an existing box culvert under the Norfolk Southern Railroad near station 365+25 Rt. The POA receives runoff from both NB and SB I-95 and the adjacent commercial properties along the north side of I-95 through a combination of closed and open drainage systems along I-95. From the POA, runoff is conveyed southwest through an existing channel in a farm field before discharging into the Christina River and ultimately, the Delaware Bay.

2.1.11 POA 11

POA 11 is located within an existing ditch along SB I-95 at the end of the project limits near station 199+60 Lt. The POA receives runoff from the travel lanes and shoulder of SB I-95. From the POA, runoff continues to flow along SB I-95 before being intercepted by a cross culvert which conveys runoff in a southeasterly direction to the Christina River and ultimately, the Delaware Bay.

2.1.12 POA 12

POA 12 is located within an existing ditch along NB I-95 at the end of the project limits near station 324+50 Rt. The POA receives runoff from the travel lanes and shoulder of NB I-95. From the POA, runoff continues to flow along NB I-95 and then turns and heads southeast to the Christina River and ultimately, the Delaware Bay.

2.2 Existing Stormwater Management Facilities

There are four existing DelDOT stormwater management BMPs located within the project limits. These BMPs currently provide qualitative and quantitative stormwater management based on the 1991 Delaware Sediment and Stormwater Regulations (DSSR). It is anticipated that all four BMPs will be impacted by the proposed improvements and be replaced with new BMPs to meet the stormwater management requirements based on the current DSSR. A description of each existing BMP is provided below.

2.2.1 BMP No. 525

BMP No. 525 is a stormwater management wet pond, located within the project limits along I-95 between station 341+00 to 345+00 Lt. The pond was constructed in 2009 under DelDOT Contract No. 29-090-02. The contributing drainage area includes the travel lanes and shoulders of I-95 from the toll plaza to the pond. For the proposed improvements, this pond will be removed as it conflicts with the ramp realignments at the interchange. It will be replaced by BMP No. 1XX and BMP No. 2XX. BMP No. 1XX will intercept most of the existing drainage previously managed by BMP No. 525 and the additional runoff created from the proposed road improvements. BMP No. 2XX will treat the remainder of the drainage area that was managed by BMP No. 525, in addition to new areas from the interchange improvements.

2.2.2 BMP No. 166

BMP No. 166 is a stormwater management wet pond located near station 353+50 to 356+00 Rt on the south side of I-95 within the project limits. The pond was constructed under DelDOT Contract 88-108-03 in 2006 and currently does not function as intended. The contributing drainage area to this facility includes portions of SR 896 and I-95. To accommodate the proposed ramp realignments and other proposed improvements, the existing BMP will be removed and replaced with BMP No. 4XX. BMP No. 4XX will be sized to manage both the drainage area to BMP No. 166 and the additional drainage area from the interchange improvements.

2.2.3 BMP No. 164

BMP No. 164 is a biofiltration swale located near stations 1+73 to 3+88 Lt on the west side of SR 896 within the project limits. The facility was constructed under DelDOT Contract 88-108-03 in 2006. The BMP drains to an existing drainage inlet at station 1+73 Lt which serves as the outlet structure. The contributing drainage area to this facility includes portions of SR 896 and existing Ramp H. To accommodate the proposed ramp realignments and other proposed improvements, this existing BMP will be removed. BMP No. 4XX will be utilized to offset the existing stormwater quality management provided by the biofiltration swale.

2.2.4 BMP No. 165

BMP No. 165 is a biofiltration swale adjacent to BMP No. 164. It is located between station 0+00 and 1+73 Lt on the west side of SR 896 within the project limits. The facility was constructed under DelDOT Contract 88-108-03 in 2006. Like BMP No. 164, it drains to an existing outlet structure at station 1+73 Lt. The contributing drainage area to this facility includes portions of SR 896. To accommodate the proposed ramp realignments and other proposed improvements, this existing BMP will be removed. BMP No. 4XX will be utilized to offset the existing stormwater quality management provided by the biofiltration swale.

3.0 Stormwater Management Approach

The project requires both qualitative and quantitative stormwater management for the proposed improvements. Currently, four existing DelDOT BMPs are located within the project limits: two stormwater management wet ponds (BMP No. 166 and No. 525) and two biofiltration swales (BMP No. 164 and No. 165). All existing BMPs are anticipated to be removed and replaced to accommodate the proposed roadway improvements and provide adequate water quality and quantity management. A description of each existing stormwater management facility is provided below. The Project Level DURMM (PLD) is in Appendix D.

3.1 Resource Protection Event (RPv)

The project is anticipated to be compliant with Section 5.2.3 of the current DSSR by implementing BMPs described in Section 13.0 of DNREC's BMP Standards and Specifications. Since these facilities utilize 48-hour extended detention, DURMM is not applicable for determining runoff reduction volume; only maximum discharge. The runoff reduction volume will be demonstrated using HydroCAD.

The proposed improvements result in an 8.45-acre increase in new impervious and a total disturbed area of 92.51 acres. To achieve compliance for the RPv storm event, four BMPs consisting of wet extended detention ponds are proposed. A description of each BMP and RPv compliance summary table is provided below.

3.1.1 BMP No. 1XX

The proposed wet pond is located between stations 427+00 and 433+00 Lt in the northwest quadrant of the interchange. The pond is situated within the infield area between proposed Ramp C and D and will replace existing BMP No. 525. The proposed pond will be designed to provide the required 48-hour detention time of the RPv storm event. The BMP receives runoff from I-95 and the proposed ramps and a large off-site wooded area located at the southwest quadrant of the interchange. The outlet structure will discharge runoff from the pond to an existing ditch upstream of an existing 54-inch RCP storm drain system that drains directly into the Christina River (LOA 5).

3.1.2 BMP No. 2XX

The proposed wet pond is located between stations 500+50 and 503+00 Rt in the northwest quadrant of the interchange. The pond is situated underneath proposed Ramp C from SB I-95 to SB SR 896 and is positioned between the proposed bridge piers. The proposed facility will be designed to provide the required 48-hour detention of the R_{Pv} storm event and receives runoff entirely from I-95. All runoff from the facility is conveyed through the proposed storm drain system under the ramp and drains directly into the Christina River (LOA 5).

3.1.3 BMP No. 3XX

The proposed wet pond is located between stations 244+00 and 251+50 Rt in the northeast quadrant of the interchange. The pond is situated within the infield area between I-95 and proposed Ramp D. The proposed facility will be designed to provide the required 48-hour detention of the R_{Pv} storm event. The BMP receives runoff from I-95, SR 896, and the proposed ramp. All runoff from the facility is conveyed through a proposed culvert under Ramp A and drains directly into the Christina River (LOA 5).

3.1.4 BMP No. 4XX

The proposed wet pond is located between Stations 728+00 and 730+50 Lt in the southeast quadrant of the interchange. The pond is situated within the area bounded by I-95, SR 896, and proposed Ramp J and will replace BMP No. 166. It will be designed to accommodate the flows previously conveyed to existing BMP No. 166 from I-95 and SR 896, the additional runoff from the proposed interchange improvements, and the off-site wooded area located at the southwest quadrant of the interchange. The proposed facility will also provide the required 48-hour detention of the R_{Pv} storm event. All runoff from the facility is conveyed through a storm drain system under Ramp J which eventually discharges to the Christina River (POA 6).

BMP No.	Drains to Point of Analysis	Contributing Area (Ac.)	Limit of Disturbance (Ac.)	R _{Pv} Runoff Reduction Credit (-) of Debit (+) (CF)
1XX	LOA 5	66.97	4.52	-198,372
2XX	LOA 5	4.10	2.54	-26,746
3XX	LOA 5	6.26	5.11	-39,378
4XX	POA 6	39.00	24.29	-172,323
PLD				41,444
Total (Net Credit)				-395,375

R_{Pv} Compliance Summary**3.2 Conveyance Event (C_v) and Flooding Event (F_v)**

The Conveyance and Flooding Event information, calculations, and supporting documentation will be provided in the Semi-Final Stormwater Management Report once the design has been further refined. It is anticipated that the proposed BMPs will provide adequate quantity stormwater management by not increasing post-development peak flows and water surface elevations for all POAs and their respective downstream receiving channels.

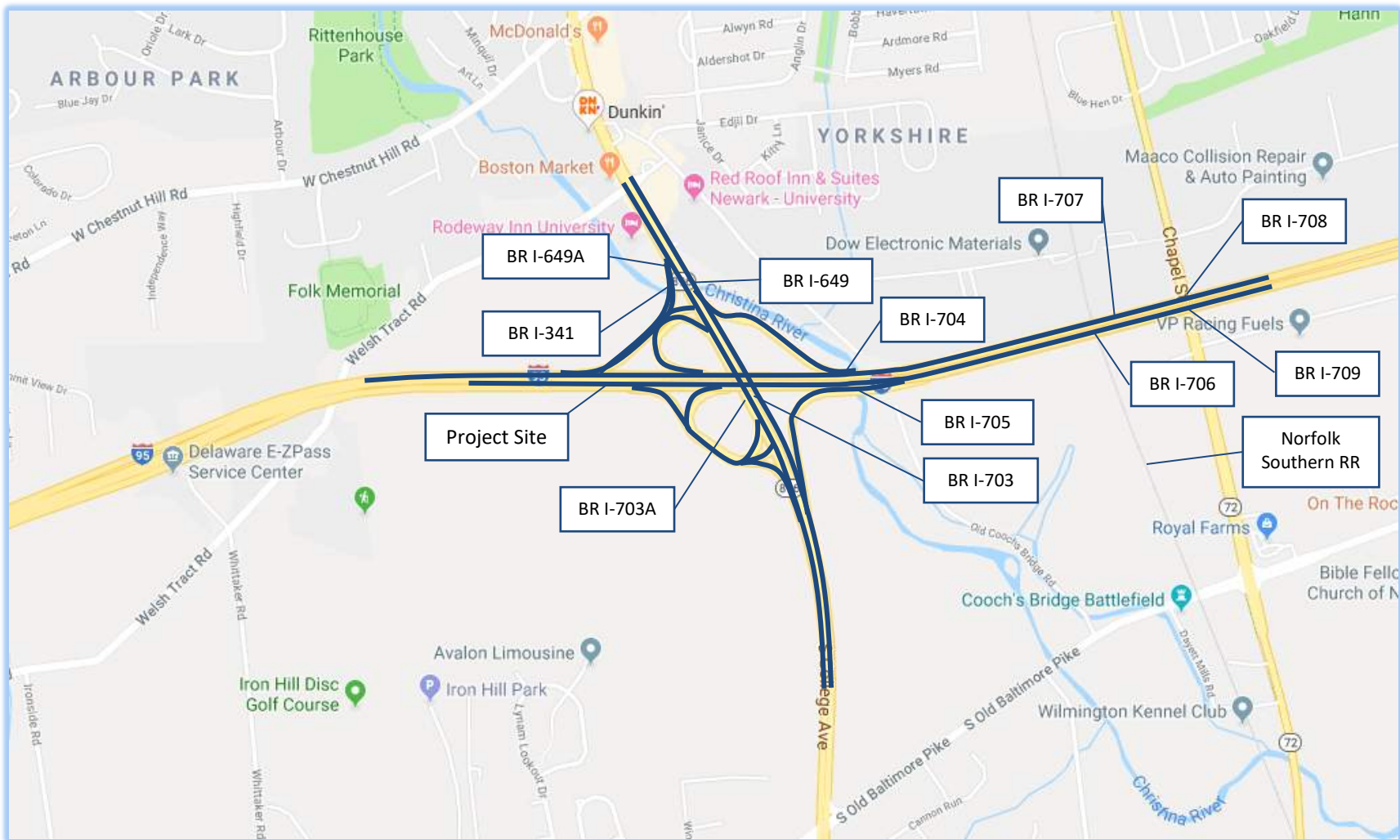
4.0 Summary

The project, located in the Christina River sub-watershed, includes interchange improvements at I-95 and SR 896 and roadway widening along I-95. The proposed improvements will require the

installation of new storm drain infrastructure and construction of four extended detention wet ponds to provide stormwater quality and quantity management. All stormwater runoff from the site drains to 11 POAs and one LOA through a combination of open and closed drainage systems that discharge to the Christina River and ultimately, the Delaware Bay.

Appendix A

Project Location Map

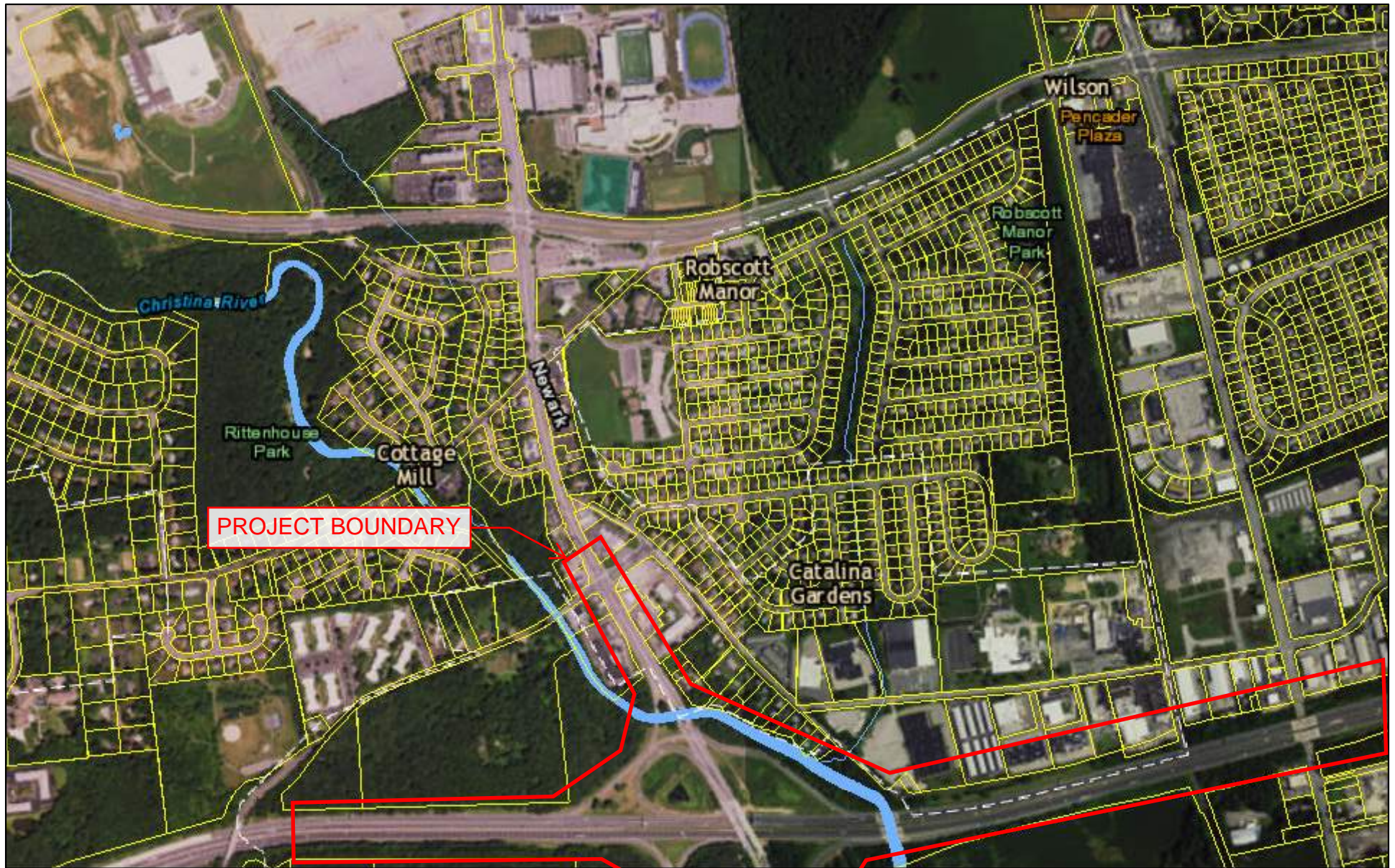


Project Location Map

Appendix B

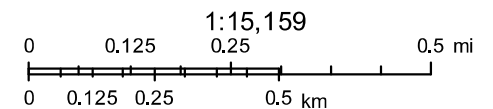
Project Background Information

Parcel Boundary w/ Water Features



December 27, 2016

- New Castle Parcels
- Sussex Parcels
- Kent Parcels
- Lakes, Ponds, Rivers
- Streams








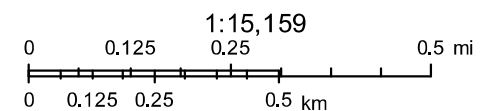
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Parcel Boundary w/ Water Features



December 27, 2016

- | | | |
|--|--|--|
|  New Castle Parcels |  Sussex Parcels |  Lakes, Ponds, Rivers |
|  Kent Parcels |  Streams | |








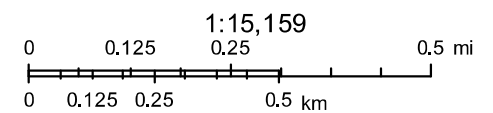
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Parcel Boundary w/ Water Features



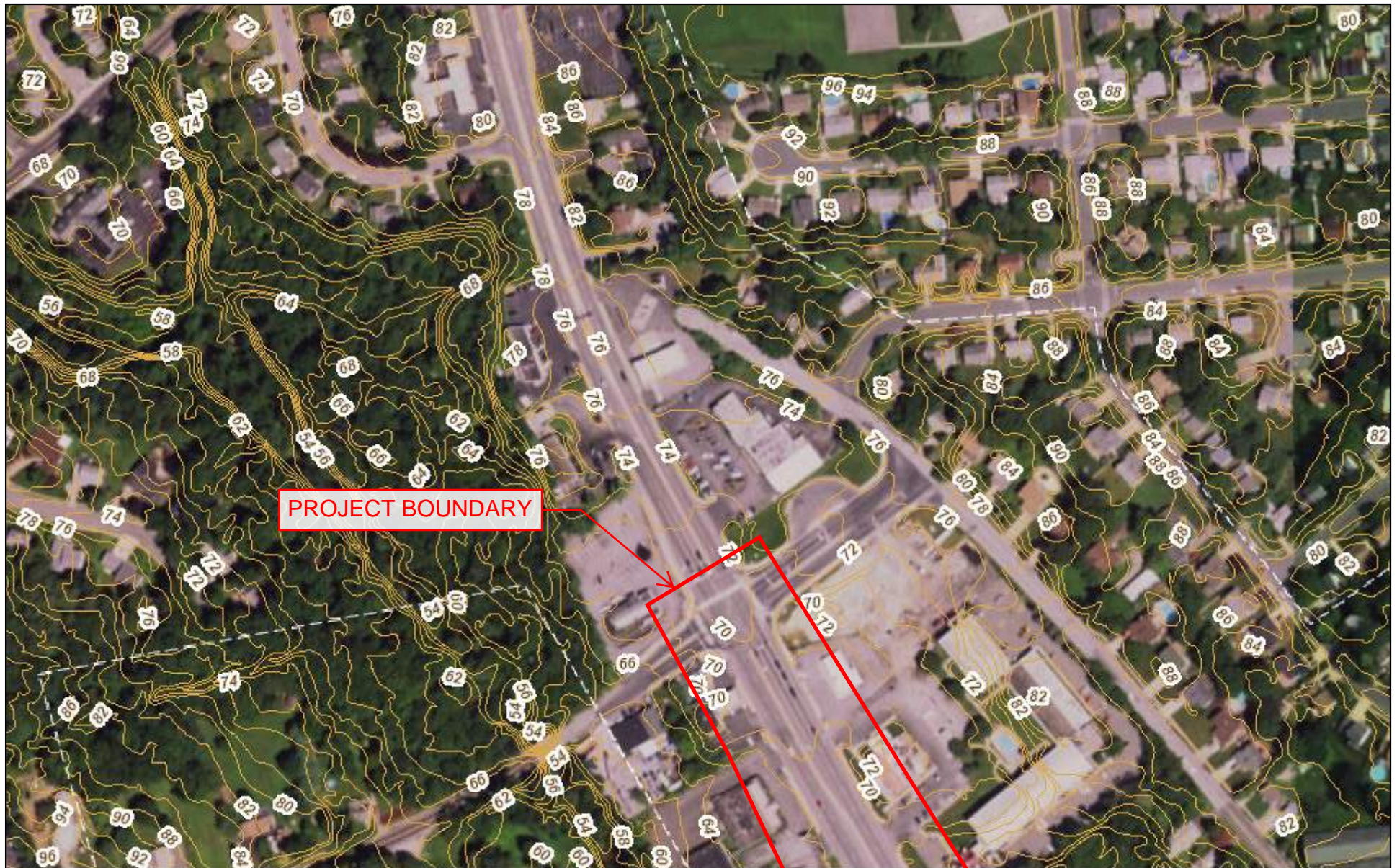
December 27, 2016

- | | | |
|--|--|--|
|  New Castle Parcels |  Sussex Parcels |  Lakes, Ponds, Rivers |
|  Kent Parcels |  Streams | |



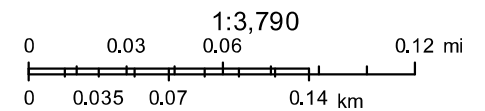
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Stormwater Assessment Study GIS



January 5, 2017

- New Castle Contours
- Sussex Contours
- Kent Contours



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

NOTE: Matchline with B5

Stormwater Assessment Study GIS



Stormwater Assessment Study GIS

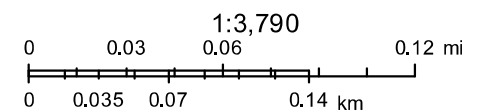


NOTE: Matchline with B7

NOTE: Matchline with B9

January 9, 2017

- New Castle Contours
- Sussex Contours
- Kent Contours



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

NOTE: Matchline with B11

Stormwater Assessment Study GIS

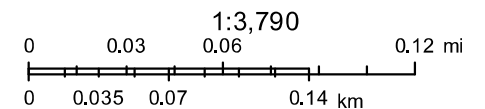


NOTE: Matchline with B8

NOTE: Matchline with B6

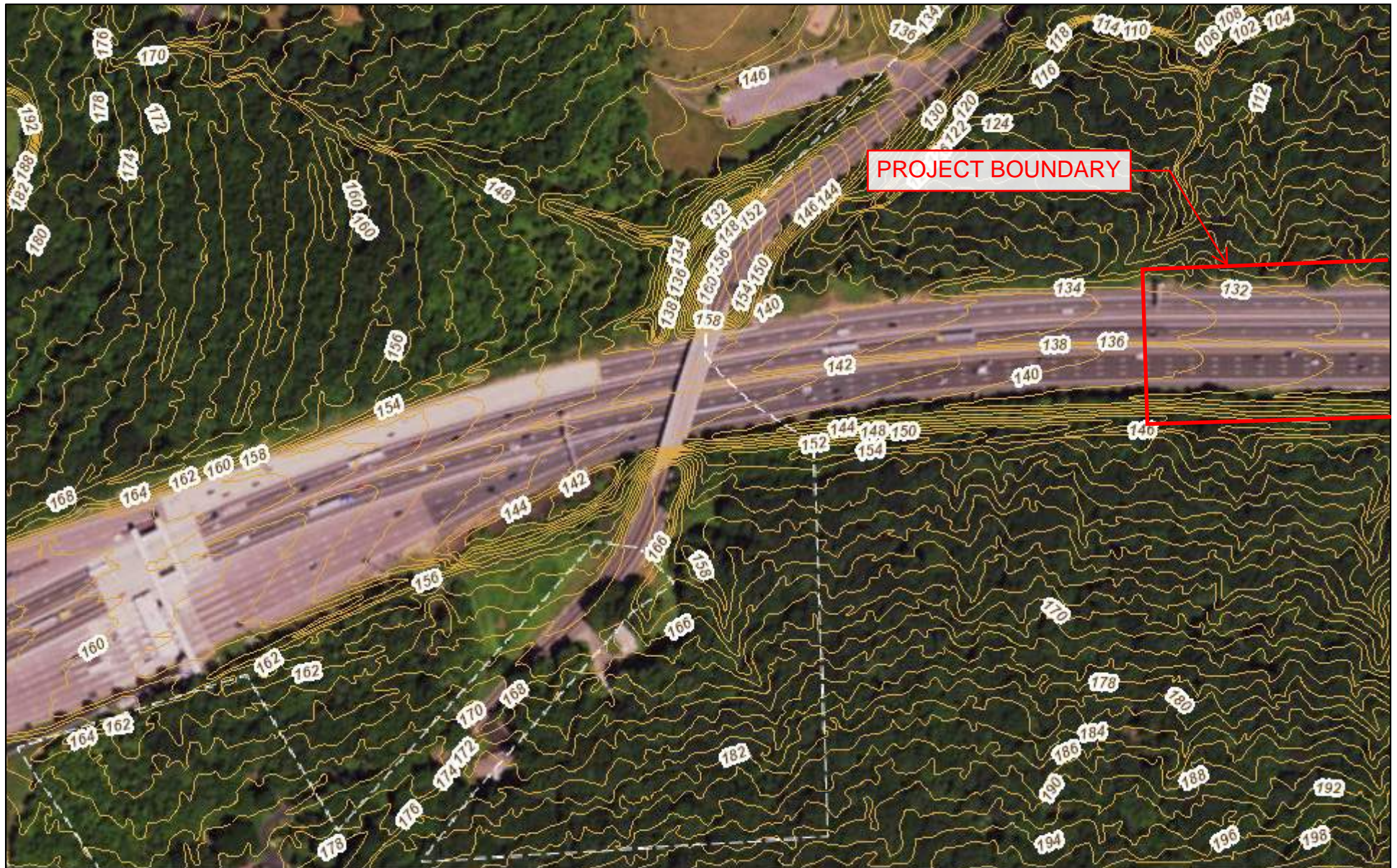
January 9, 2017

- New Castle Contours
- Sussex Contours
- Kent Contours



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

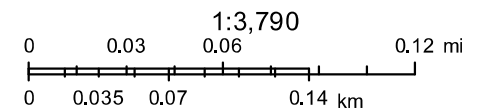
Stormwater Assessment Study GIS



NOTE: Matchline with B7

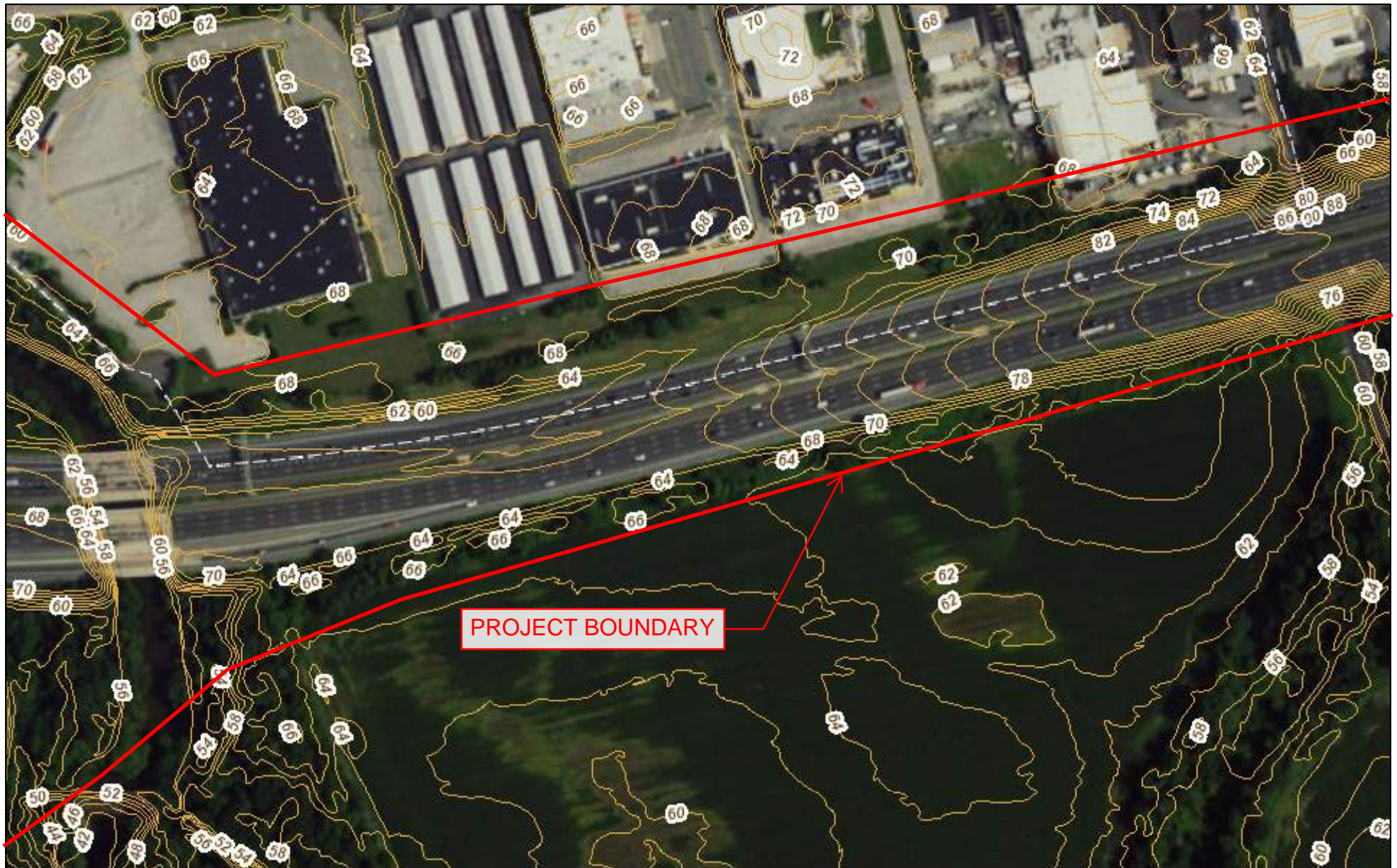
January 9, 2017

- New Castle Contours
- Sussex Contours
- Kent Contours



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Stormwater Assessment Study GIS

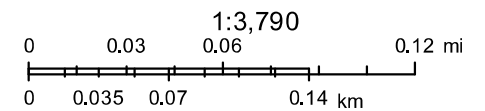


NOTE: Matchline with B6

NOTE: Matchline with B10

January 9, 2017

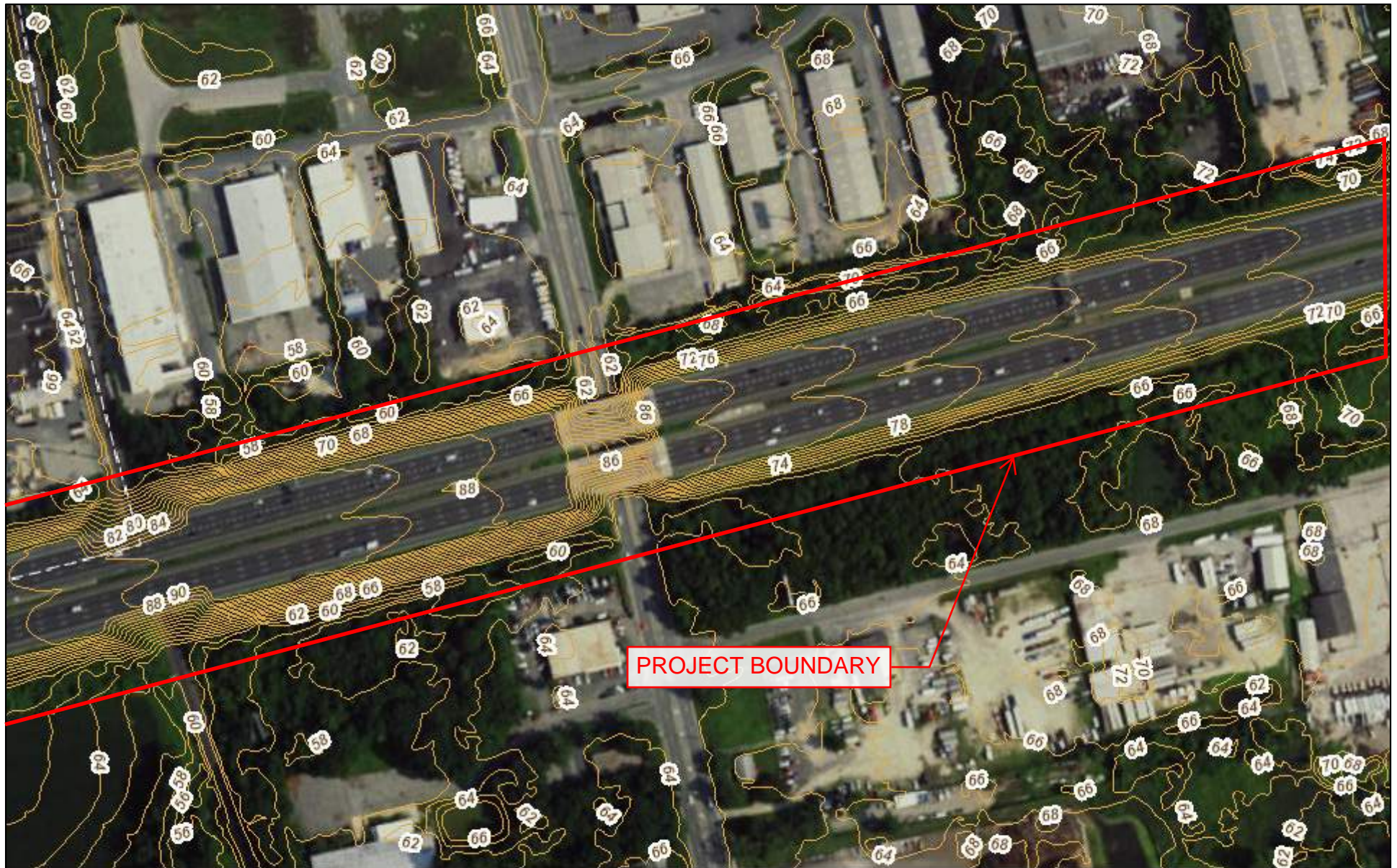
- New Castle Contours
- Sussex Contours
- Kent Contours



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

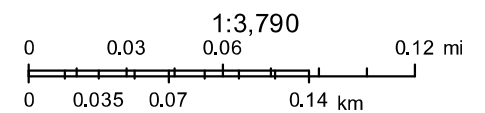
Stormwater Assessment Study GIS

NOTE: Matchline with B9



January 9, 2017

- New Castle Contours
- Sussex Contours
- Kent Contours



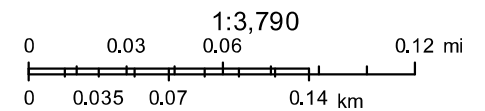
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Stormwater Assessment Study GIS



January 9, 2017

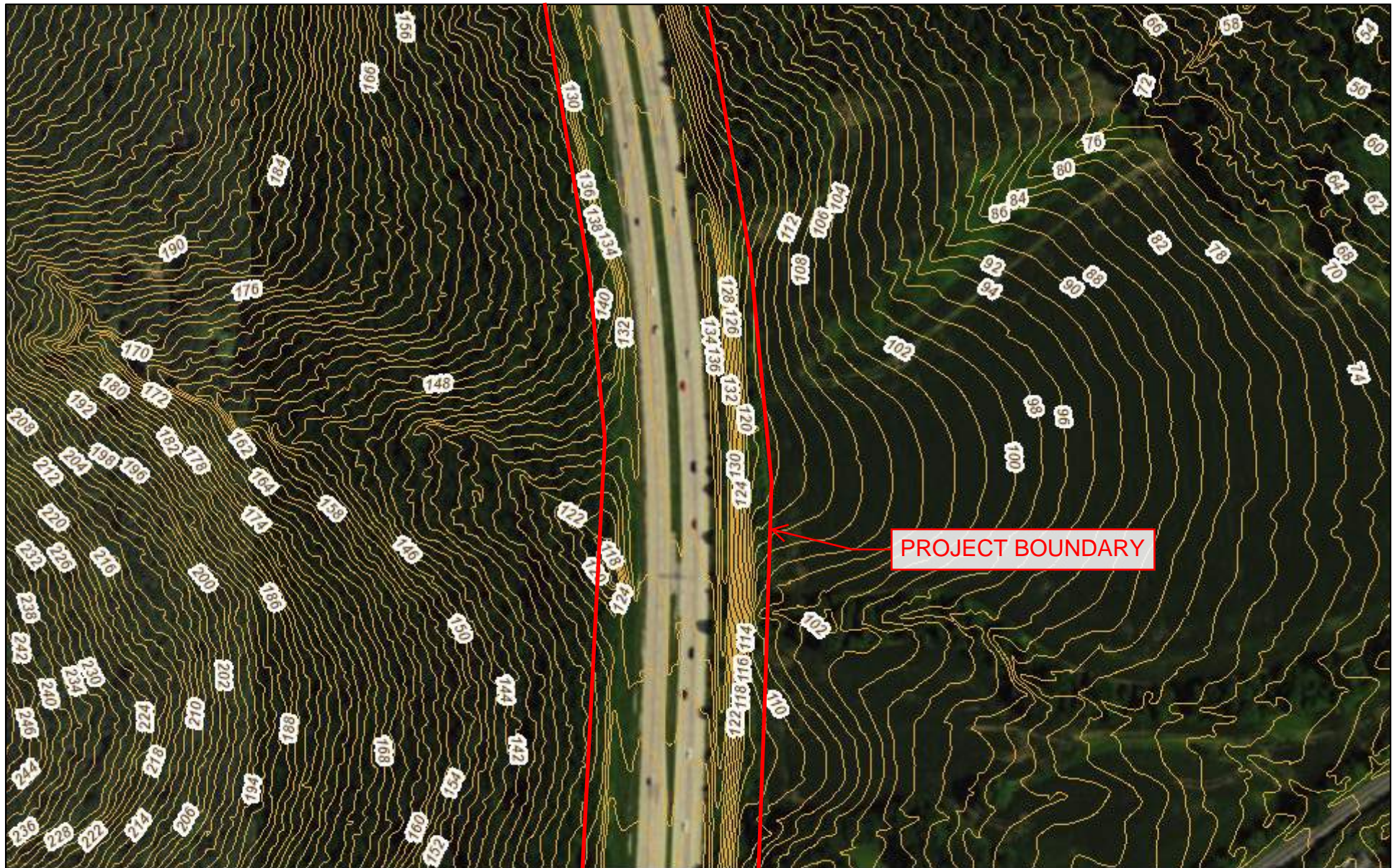
- New Castle Contours
- Sussex Contours
- Kent Contours



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

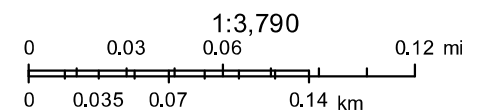
NOTE: Matchline with B12

Stormwater Assessment Study GIS



January 9, 2017

- New Castle Contours
- Sussex Contours
- Kent Contours



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

NOTE: Matchline with B13

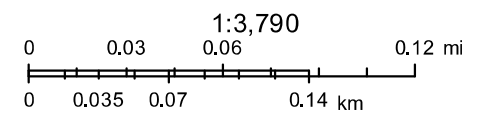
B12

Stormwater Assessment Study GIS



January 9, 2017

- New Castle Contours
- Sussex Contours
- Kent Contours



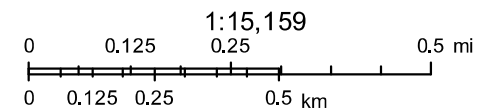
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Tax Ditch Information



December 27, 2016

*NOTE - There are not any tax ditches present within the project boundary



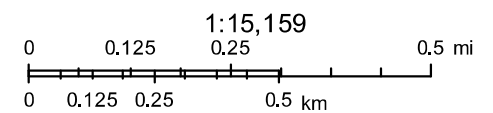
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Tax Ditch Information



December 27, 2016

***NOTE - There are not any tax ditches present within the project boundary**



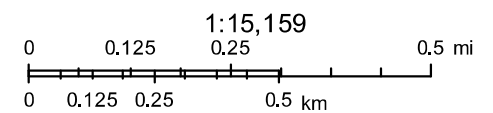
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Tax Ditch Information



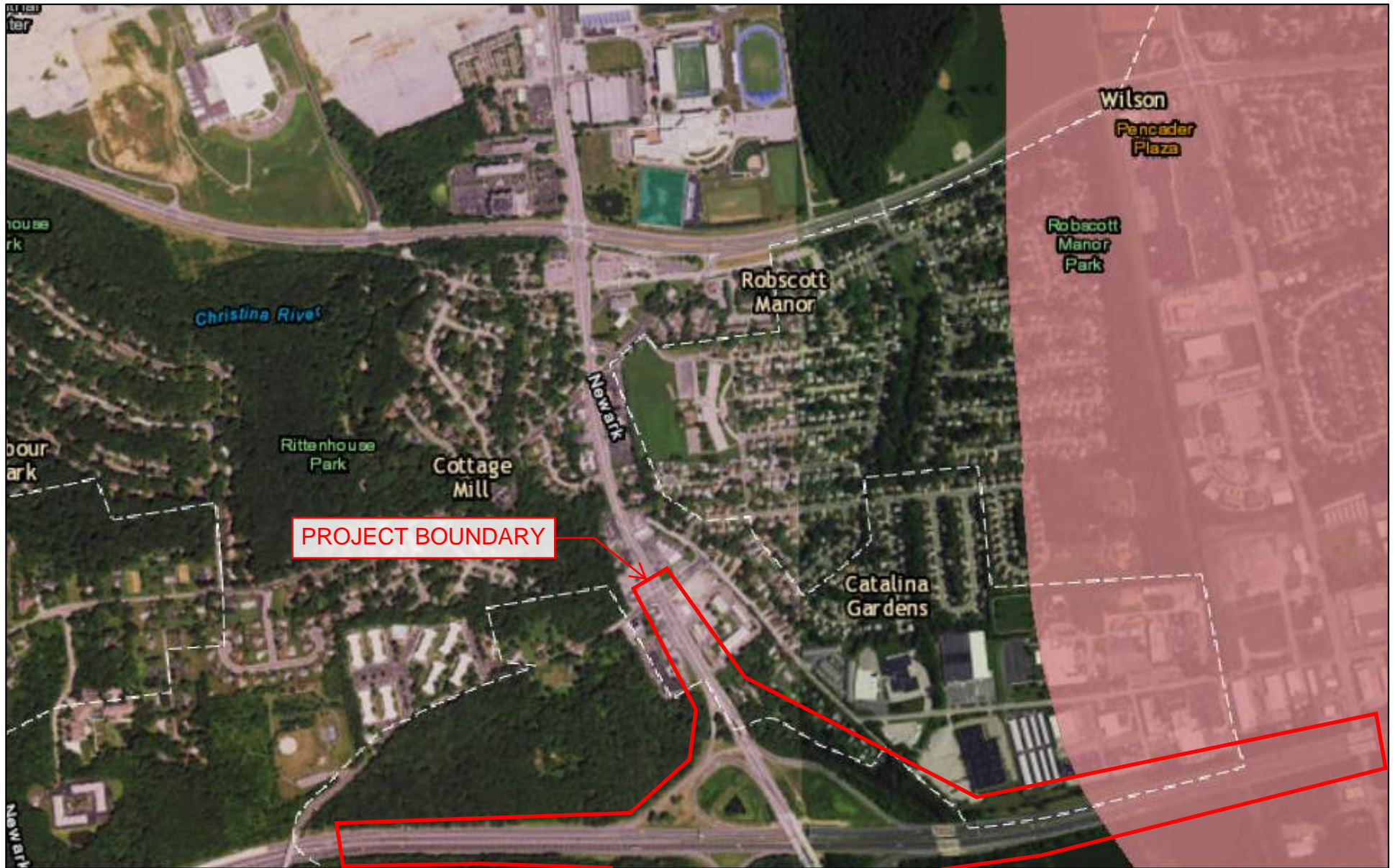
December 27, 2016

***NOTE - There are not any tax ditches present within the project boundary**



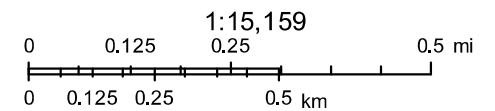
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Wellhead Protection Areas



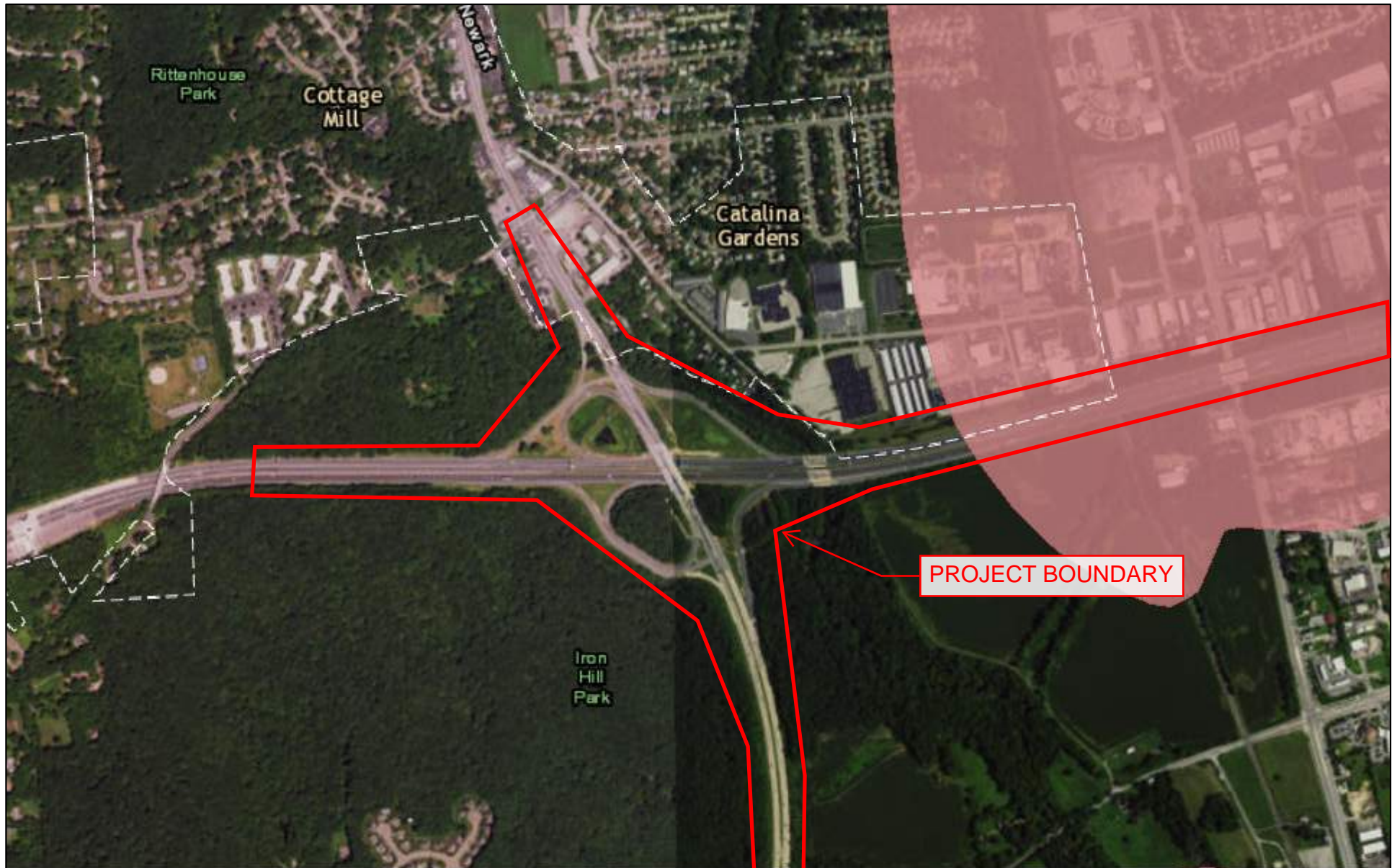
December 27, 2016

 Well Head Protection Areas



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Wellhead Protection Areas



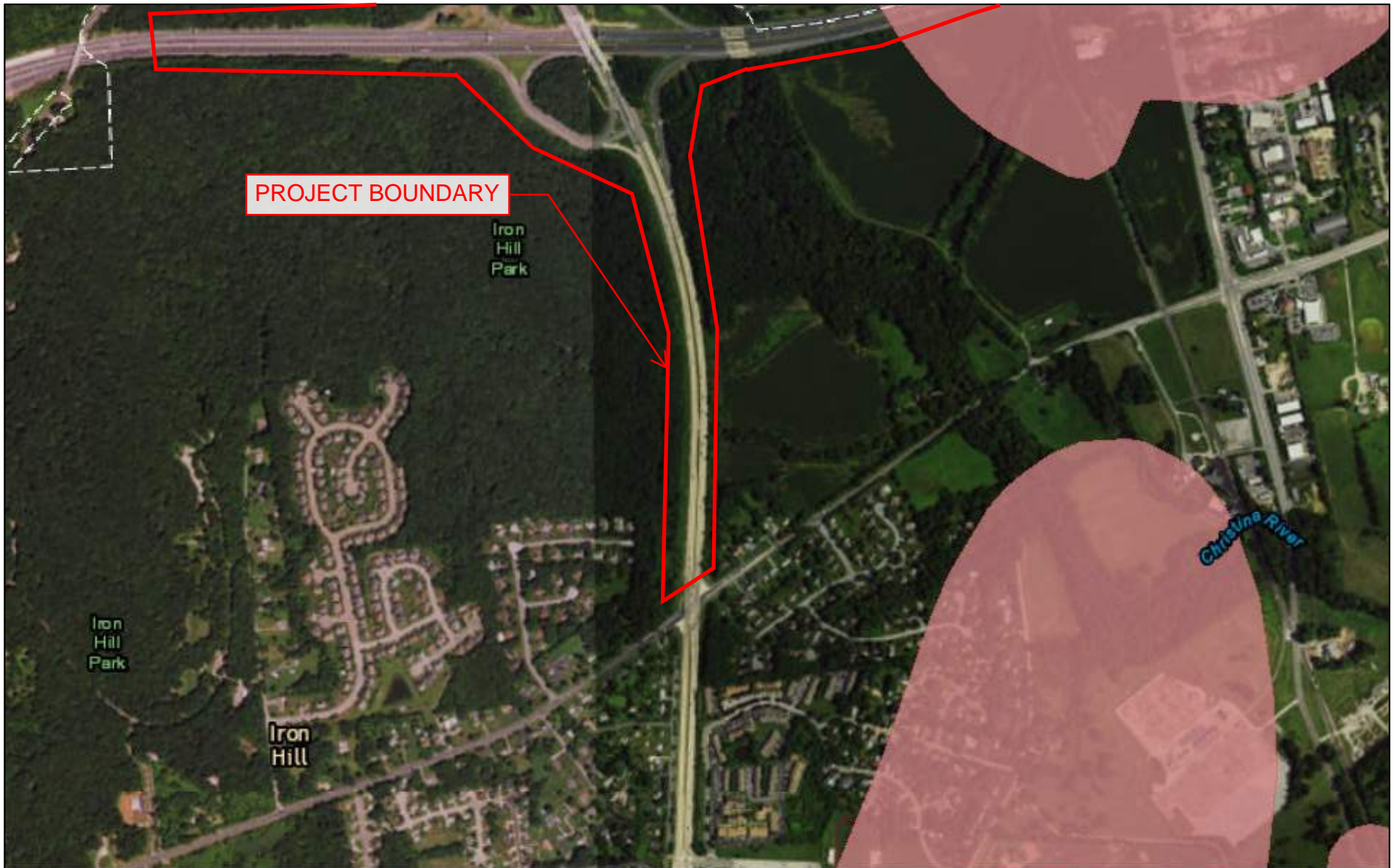
December 27, 2016

Well Head Protection Areas

1:15,159
0 0.125 0.25 0.5 mi
0 0.125 0.25 0.5 km

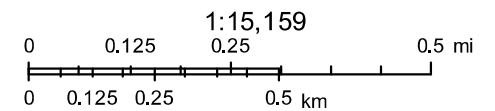
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Wellhead Protection Areas



December 27, 2016

Well Head Protection Areas




Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

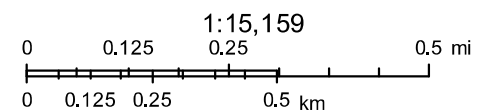
Aquifer Recharge Areas



December 27, 2016

Aquifer Recharge Areas

 Excellent Recharge Area



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

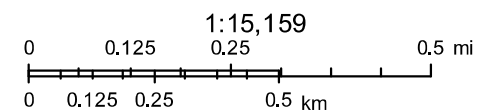
Aquifer Recharge Areas



December 27, 2016

Aquifer Recharge Areas

 Excellent Recharge Area




Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

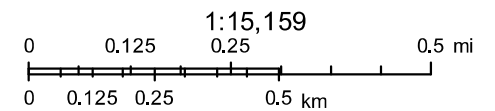
Aquifer Recharge Areas



December 27, 2016

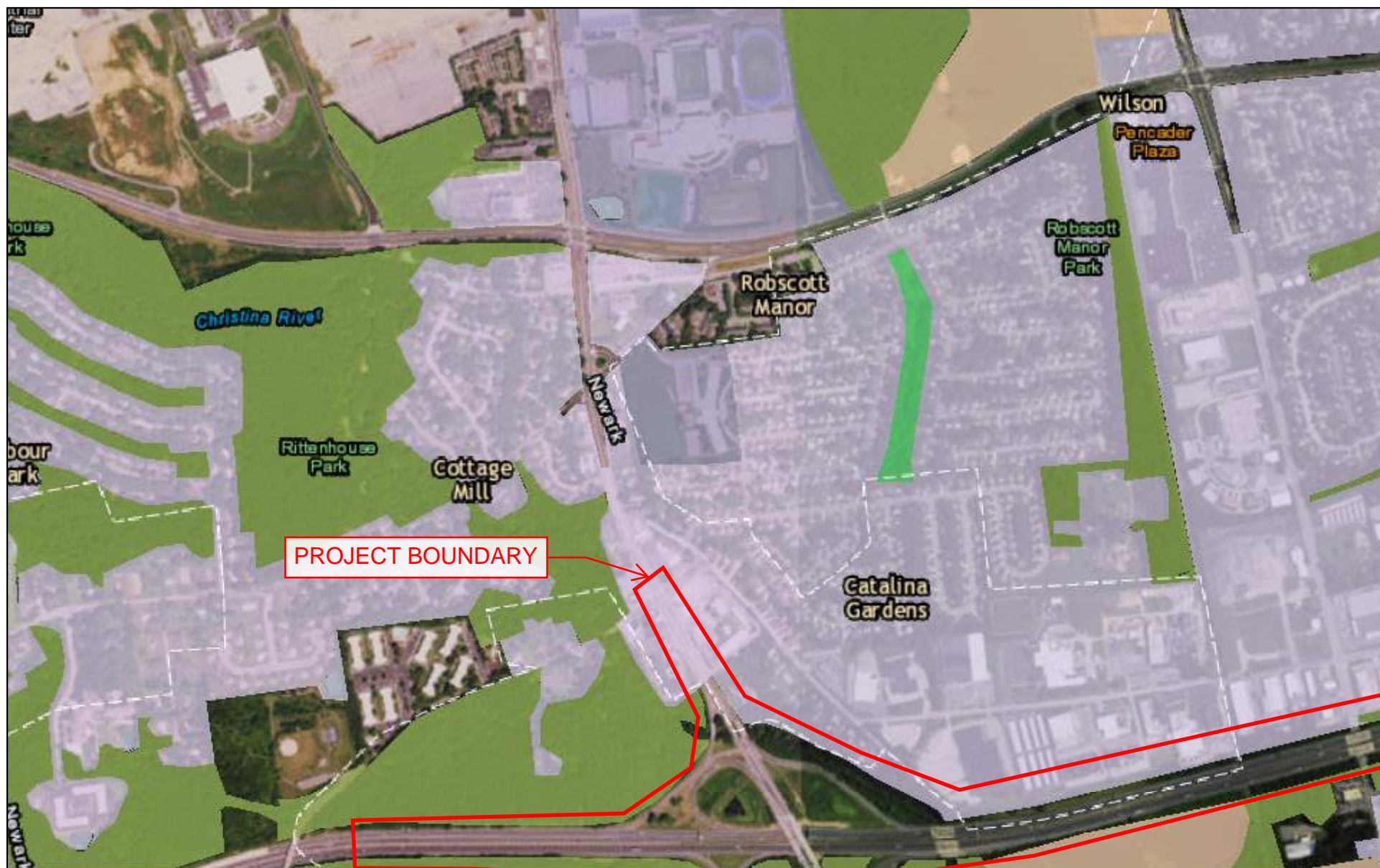
Aquifer Recharge Areas

 Excellent Recharge Area



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

2007 Land Use/Land Cover



December 27, 2016

Landuse/Landcover 2007

Single Family Dwellings

Retail Sales/Wholesale/Professional Services

Mixed Urban or Built-up Land

Other Urban or Built-up Land

Institutional/Governmental

Cropland

Deciduous Forest

Evergreen Forest

Man-made Reservoirs and Impoundments

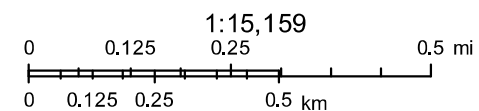
Non-tidal Forested Wetland

Transitional (incl. cleared, filled, and gra

Mixed Forest

Non-tidal Open Water

Recreational



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

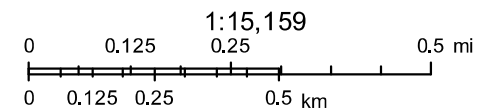
2007 Land Use/Land Cover



December 27, 2016

Landuse/Landcover 2007

Non-tidal Emergent Wetland	Other Urban or Built-up Land	Mixed Forest
Single Family Dwellings	Institutional/Governmental	Farmsteads and Farm Related Buildings
Retail Sales/Wholesale/Professional Services	Cropland	Non-tidal Open Water
Mixed Urban or Built-up Land	Deciduous Forest	Recreational
	Non-tidal Forested Wetland	



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

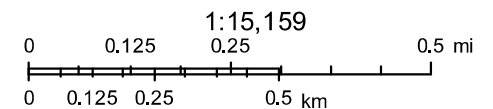
2007 Land Use/Land Cover



December 27, 2016

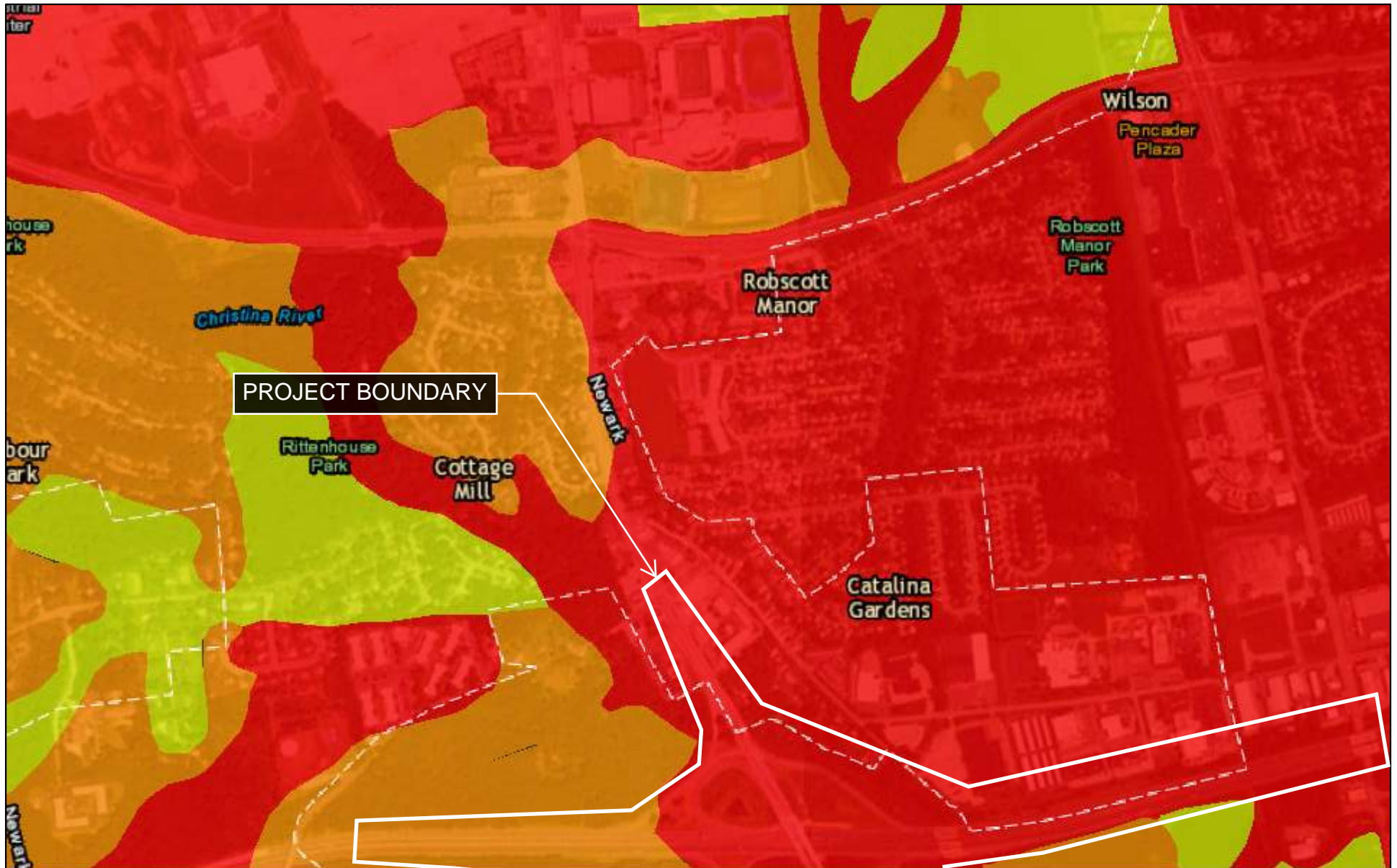
Landuse/Landcover 2007

Non-tidal Emergent Wetland	Other Urban or Built-up Land	Man-made Reservoirs and Impoundments	Mixed Forest
Single Family Dwellings	Institutional/Governmental	Non-tidal Forested Wetland	Farmsteads and Farm Related Buildings
Retail Sales/Wholesale/Professional Services	Cropland	Non-tidal Scrub/Shrub Wetland	Non-tidal Open Water
Mixed Urban or Built-up Land	Deciduous Forest	Mobile home Parks/Courts	
	Evergreen Forest	Idle Fields	



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Hydrologic Soil Group

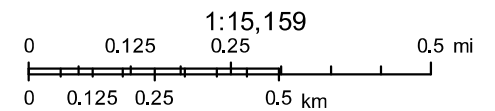


December 27, 2016

SOILS HSG ■ D

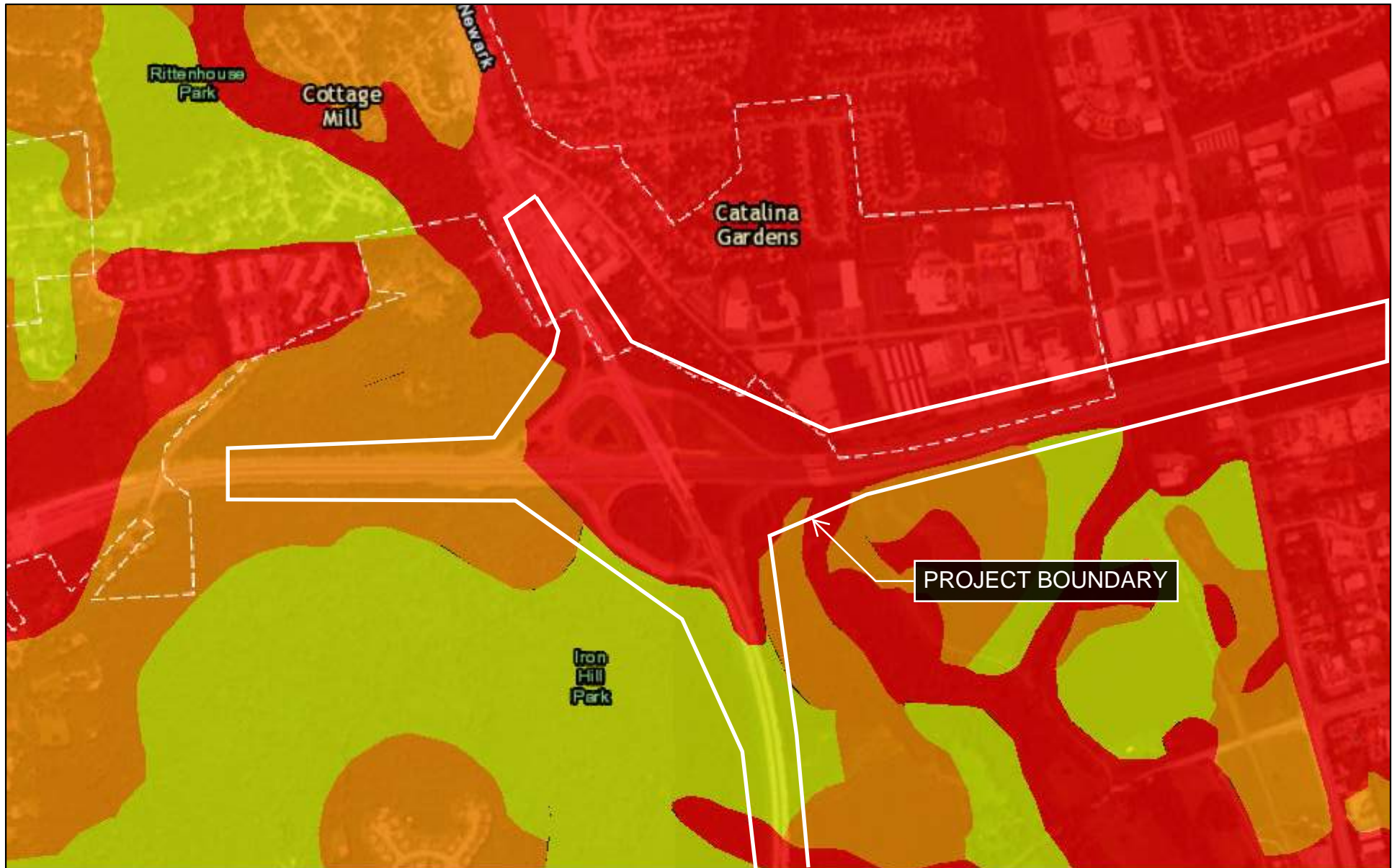
■ B

■ C



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Hydrologic Soil Group

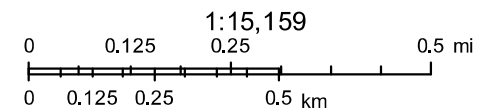


December 27, 2016

SOILS HSG ■ D

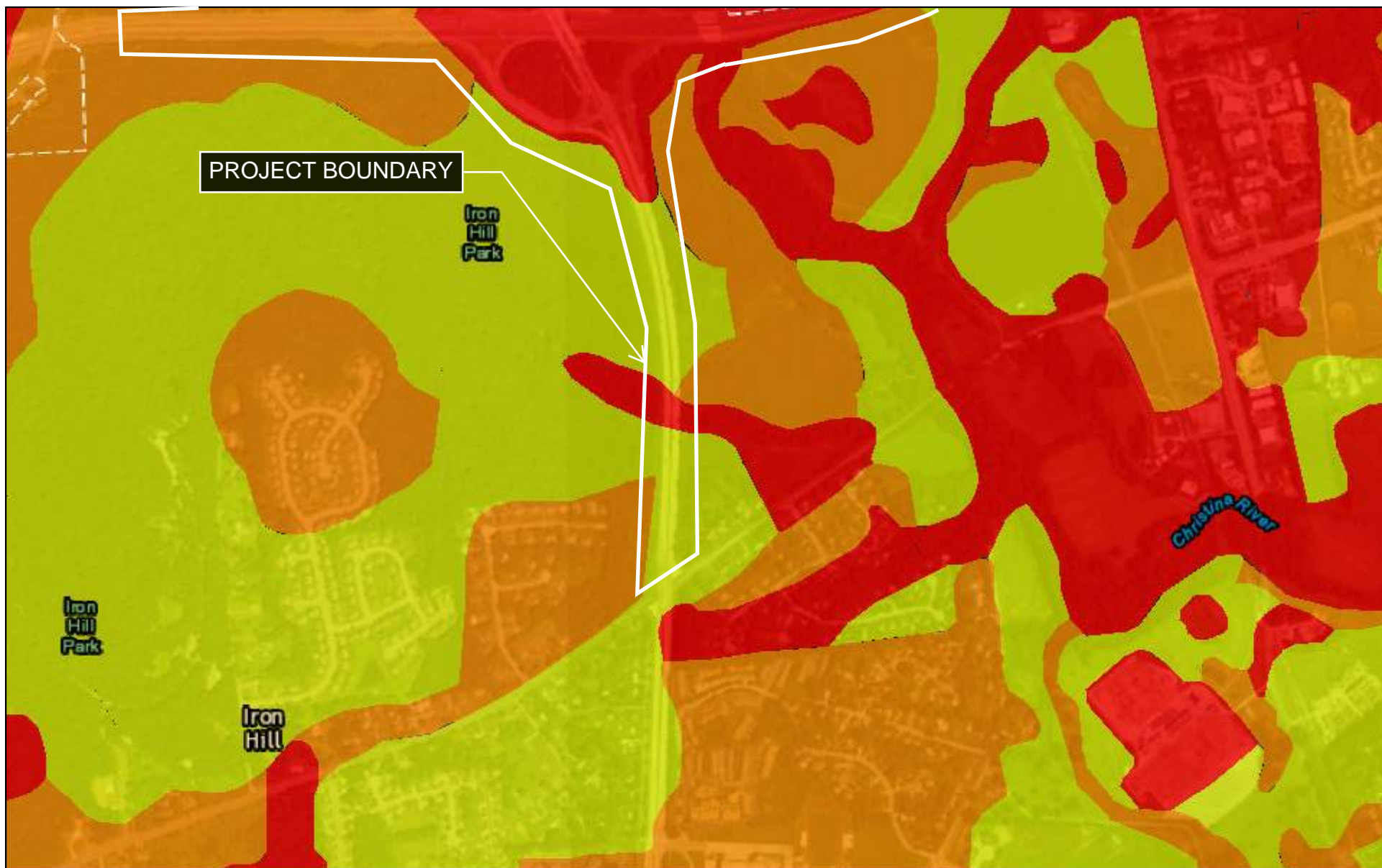
■ B

■ C



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Hydrologic Soil Group

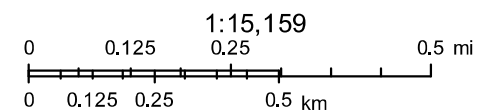


December 27, 2016

SOILS HSG D

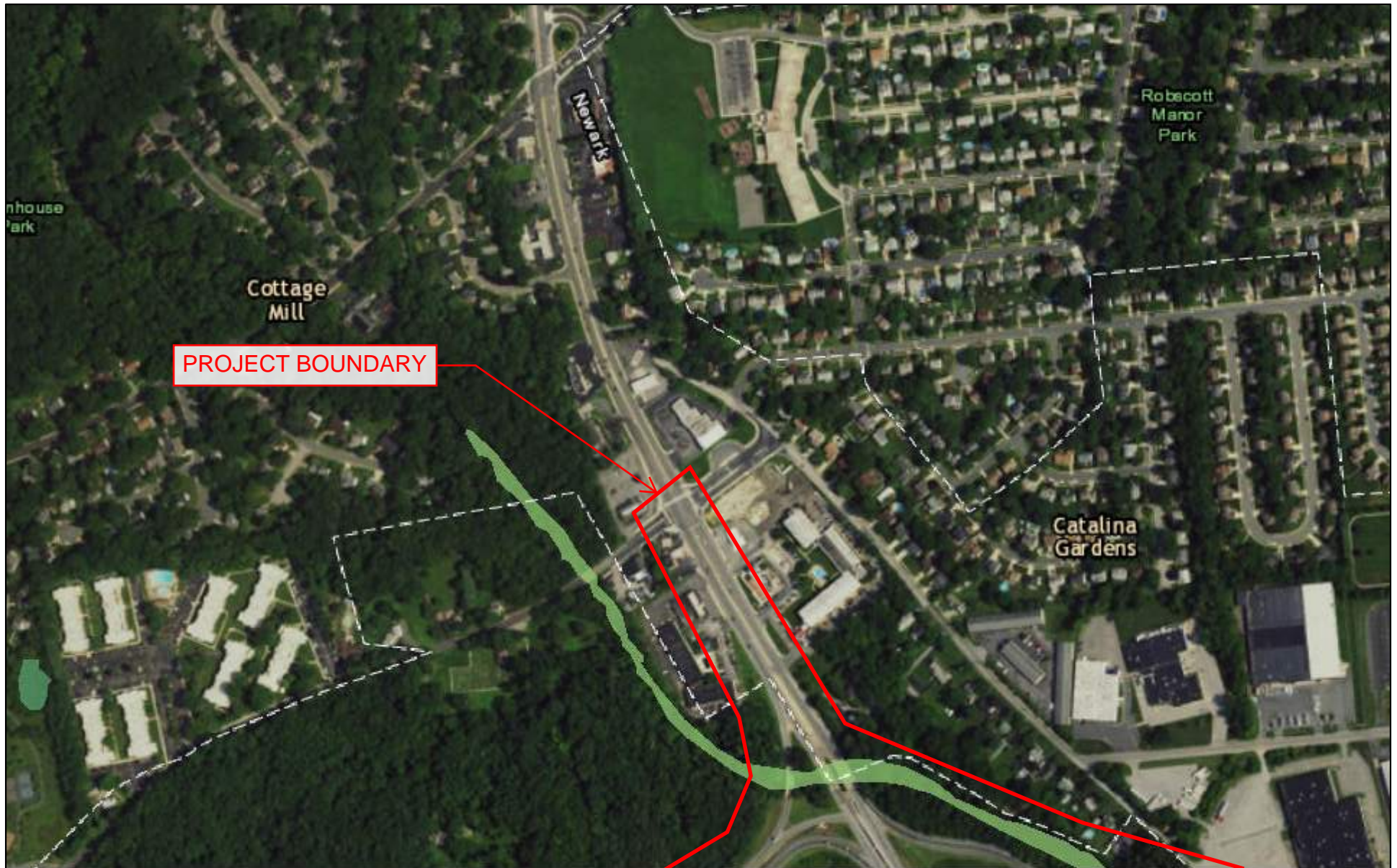
B

C



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Stormwater Assessment Study GIS

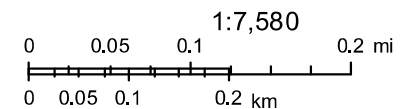


January 9, 2017

State Wetlands Mapping Project

- Palustrine Emergent
- Riverine Non-vegetated

NOTE: Matchline with B34



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Stormwater Assessment Study GIS

NOTE: Matchline with B35

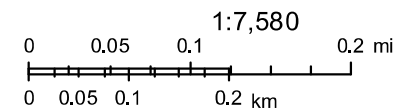


NOTE: Matchline with B36

January 9, 2017

State Wetlands Mapping Project

- Palustrine Forested Deciduous
- Riverine Non-vegetated



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

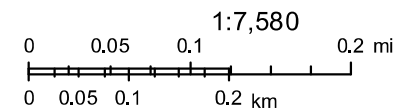
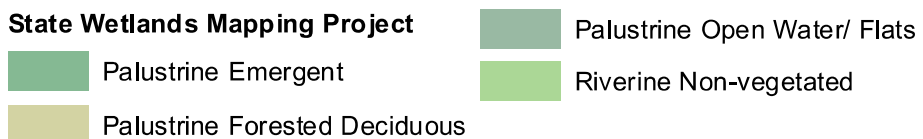
NOTE: Matchline with B37

Stormwater Assessment Study GIS



January 9, 2017

State Wetlands Mapping Project



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Stormwater Assessment Study GIS

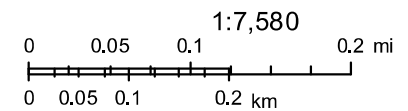


January 9, 2017

State Wetlands Mapping Project

- Palustrine Emergent
- Palustrine Forested Deciduous

Riverine Non-vegetated



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Stormwater Assessment Study GIS



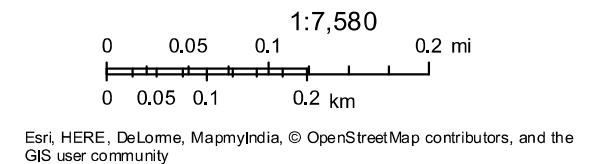
January 9, 2017

State Wetlands Mapping Project

- Palustrine Emergent
- Palustrine Forested Deciduous

Riverine Non-vegetated

NOTE: Matchline with B38









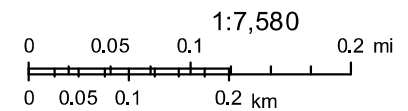
Stormwater Assessment Study GIS



January 9, 2017

State Wetlands Mapping Project

	Palustrine Emergent		Palustrine Open Water/ Flats
	Palustrine Forested Deciduous		Palustrine Scrub/shrub
			Riverine Non-vegetated

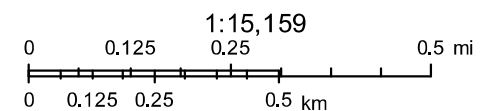


Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Runoff Reduction Feasibility



December 27, 2016

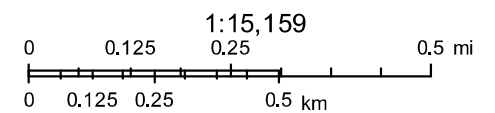


Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Runoff Reduction Feasibility



December 27, 2016

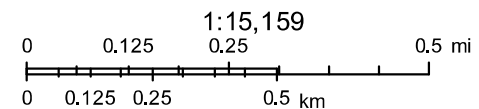


Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Runoff Reduction Feasibility



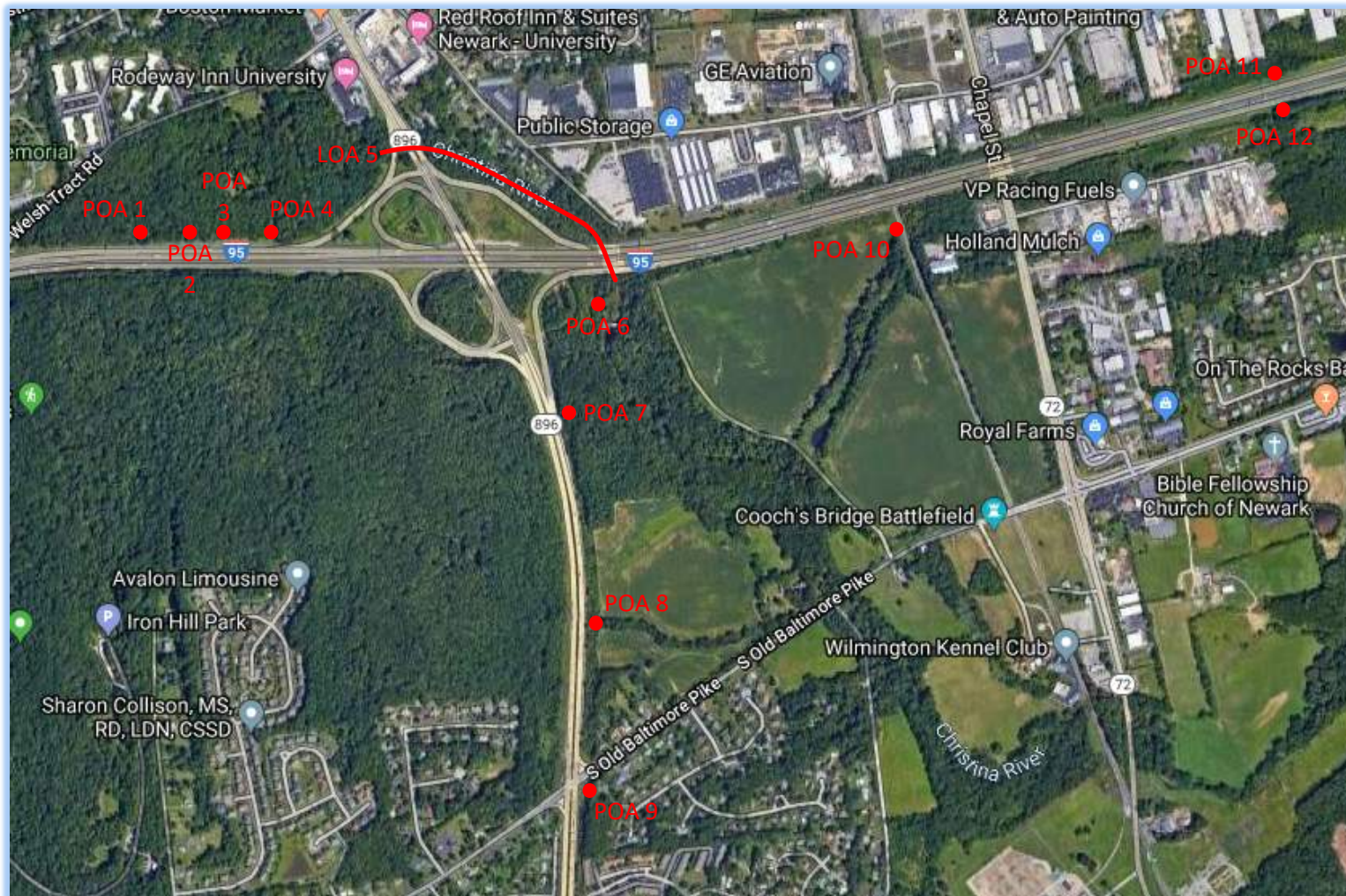
December 27, 2016



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Appendix C

Point of Analysis Location Map



Point of Analysis Location Map

Appendix D

Project Level DURMM

CONTRIBUTING AREA RUNOFF CURVE NUMBER (C.A. RCN) WORKSHEET

Total Contributing Area w. Upstream Areas (ac)	92.5
Weighted Runoff Curve Number (RCN)	84

PROJECT:	T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID:	Project Level DURMM
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	STD

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data

- 1.1 HSG Area Within LOD (ac)
- 1.2 Pre-Developed Woods/Meadow Within LOD (ac)
- 1.3 Pre-Developed Impervious Within LOD (ac)
- 1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); OR
- 1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)

HSG A	HSG B	HSG C	HSG D
0	12	1.6	78.91
0	0	0	0
0	1.13	0.16	17.38
0	3.5	0.19	23.43
0%	29%	12%	30%

Step 2 - Subarea LOD Runoff Calculations

- 2.1 RCN per HSG
- 2.2 RPv per HSG (in.)
- 2.3 Target RCN per HSG
- 2.4 Target Runoff per HSG (in.)

0.00	71.79	76.85	85.34
0.00	0.97	1.17	1.58
0.00	63.96	76.04	83.37
0.00	0.73	1.14	1.47

- 2.5 Subarea LOD (ac)
- 2.6 Subarea Weighted RCN
- 2.7 Subarea Weighted RPv (in.)
- 2.8 Subarea Weighted Target Runoff (in.)

92.51
83.44
1.49
1.37

Step 3 - Upstream LOD Areas (from previous DURMM Report as applicable)

- 3.1 Upstream Sub-Area ID
- 3.2 Upstream Contributing Area (ac)
- 3.3 Target Runoff for Upstream Area (in.)
- 3.4 Adjusted CN after all reductions
- 3.5 Adjusted RPv (in.)
- 3.6 Adjusted Cv (in.)
- 3.7 Adjusted Fv (in.)

Area 1	Area 2	Area 3	Area 4

Step 4 - RPv Calculations for Combined LOD

- 4.1 Combined LOD (ac)
- 4.2 Weighted RCN
- 4.3 Weighted RPv (in.)
- 4.4 Weighted Target Runoff (in.)
- 4.5 Estimated Annual Runoff (in.)
- 4.6 Req'd Runoff to be Managed within LOD (in.)
- 4.7 Req'd Runoff to be Managed within LOD (%)

92.51
83.44
1.49
1.37
21.23
0.12
8%

PROJECT:	T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID:	Project Level DURMM
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	STD

**OUTSIDE LIMIT OF DISTURBANCE
(OLOD) WORKSHEET**

Step 1 - Site Data

1.1 Total Contributing Area (ac)	N/A
1.2 C.A. RCN	N/A
1.3 LOD Area (ac)	N/A
1.4 LOD RCN	N/A
1.5 Outside LOD Area (ac)	N/A
1.6 Outside LOD RCN	N/A

Step 2 - Time of Concentration

	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
FLOW TYPE						
<i>Sheet</i>				-----	N/A	0.00
				-----	N/A	0.00
				-----	N/A	0.00
<i>Shallow Concentrated</i>				N/A	-----	0.00
				N/A	-----	0.00
				N/A	-----	0.00
<i>Open Channel</i>			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
2.7 Time of Concentration (Tc)						0.10

Sheet Flow Surface Codes

a smooth surface	f grass, dense
b fallow (no residue)	g grass, bermuda
c cultivated < 20% Res.	h woods, light
d cultivated > 20% Res.	i woods, dense
e grass - range, short	j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

3.1 Unit Hydrograph Type	STD	
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	#N/A	#N/A
3.5 Ia/P ratio	#N/A	#N/A
3.6 Unit Peak Discharge, qu (csm/in)	#N/A	#N/A
3.7 Runoff (in.)	#VALUE!	#VALUE!
3.8 Peak Discharge, qp (cfs)	#VALUE!	#VALUE!
3.9 Equiv. unit peak discharge (cfs/ac)	0.00	0.00

PROJECT: T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID: Project Level DURMM
LOCATION (County): New Castle

RESOURCE PROTECTION EVENT (RPv) WORKSHEET

Step 1 - Calculate Initial RPv

- 1.1 Total contributing area to BMP (ac)
- 1.2 Initial RCN
- 1.3 RPv for Contributing Area (in.)
- 1.4 Req'd RPv to be Managed for Contributing Area (in.)
- 1.5 Req'd RPv to be Managed for Contributing Area (%)

	BMP 1		BMP 2		BMP 3		BMP 4		BMP 5
Type	0-No BMP	Type	--	Type	--	Type	--	Type	--
Data									
92.51									
83.44									
1.49									
0.12									
8%									

Step 2 - Adjust for Retention Reduction

- 2.1 Retention volume provided (cu. ft.)
- 2.2 Retention reduction allowance (%)
- 2.3 Retention reduction volume (ac-ft)
- 2.4 Retention reduction volume (in.)
- 2.5 Runoff volume after retention reduction (in.)
- 2.6 Adjusted CN*

0%		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
1.49		N/A		N/A		N/A		N/A	
83.77		N/A		N/A		N/A		N/A	

Step 3 - Adjust for Annual Runoff Reduction

- 3.1 Annual CN (ACN)
- 3.2 Annual runoff (in.)
- 3.3 Proportion A/B soils in BMP footprint (%)
- 3.4 Annual runoff reduction allowance (%)
- 3.5 Annual runoff after reduction (in.)
- 3.6 Adjusted ACN
- 3.7 Annual Runoff Reduction Allowance for RPv (in.)

83.44		N/A		N/A		N/A		N/A	
21.23		N/A		N/A		N/A		N/A	
0%		0%		0%		0%		0%	
0%		N/A		N/A		N/A		N/A	
21.23		N/A		N/A		N/A		N/A	
83.44		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	

Step 4 - Calculate RPv with BMP Reductions

- 4.1 RPv Runoff Manangement Provided (cu. ft.)
- 4.2 RPv runoff volume after all reductions (in.)
- 4.3 RPv runoff volume after all reductions (cu.ft.)
- 4.4 Total RPv runoff reduction (in.)
- 4.5 Total RPv runoff reduction (%)
- 4.6 Adjusted CN after all reductions*
- 4.7 Adjusted equivalent annual runoff (in.)
- 4.8 RPv Compliance Met Through Runoff Reduction?
- 4.9 Runoff Reduction Credit, if Applicable (cu.ft)

0		N/A		N/A		N/A		N/A	
1.49		N/A		N/A		N/A		N/A	
501,162		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
0%		N/A		N/A		N/A		N/A	
83.44		N/A		N/A		N/A		N/A	
21.23		N/A		N/A		N/A		N/A	
NO		N/A		N/A		N/A		N/A	
N/A		N/A		N/A		N/A		N/A	

Step 5 - Determine Residual Volume to be Managed or Offset

- 5.1 RPv Residual Volume (in.)
- 5.2 RPv Residual Volume (cu.ft./ac)
- 5.3 Residual Volume to be Managed or Offset (cu.ft.)
- 5.4 RPv avg. discharge rate for 48-hr detention (cfs)
- 5.5 RPv max. discharge rate for 48-hr detention (cfs)

0.12		N/A		N/A		N/A		N/A	
448		N/A		N/A		N/A		N/A	
41,444		N/A		N/A		N/A		N/A	
0.240		N/A		N/A		N/A		N/A	
1.199		N/A		N/A		N/A		N/A	

*NOTE: No additional runoff reduction credit can be taken for surface recharge practices once the "Adjusted CN after all reductions" (Step 4.6) reaches the equivalent CN for the native soil-cover condition of the BMP footprint itself (i.e. for Sheet Flow to Turf Filter Strip on B soils Step 4.6 cannot be below 61). If this occurs contact the DNREC – SSP for further guidance

PROJECT: T201609002 I-95 and SR 896 Interchange

DRAINAGE SUBAREA ID: Project Level DURMM

TMDL WATERSHED: Christina River

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

Step 1 - Calculate Annual Runoff Volume 1.1 Total contributing area to BMP (ac) 1.2 Initial RCN 1.3 Annual runoff volume (in.) 1.4 Annual runoff volume (liters)	BMP 1			BMP 2				BMP 3				BMP 4				BMP 5				
	Type:	0-No BMP			Type:	--			Type:	--			Type:	--			Type:	--		
	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
	92.51																			
	83																			
21.23																				
2.02E+08																				

Step 2 - Calculate Annual Pollutant Load 2.1 EMC (mg/L) 2.2 Load (mg/yr) 2.3 Stormwater Load (lb/ac/yr)		2.80	0.49	90		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
		5.65E+08	9.89E+07	1.82E+10		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	
		13.47	2.36	432.98		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	

Step 3 - Adjust for Pollutant Reduction 3.1 BMP annual runoff reduction (%) 3.2 Adjusted annual runoff volume (in) 3.3 Adjusted annual runoff volume (liters) 3.4 Adjusted load from annual reductions (lb/ac/yr) 3.5 BMP removal efficiency (%) 3.6 BMP effluent concentration (mg/L) 3.7 Final Adjusted load (lb/ac/yr)	0%				N/A				N/A				N/A				N/A						
	21.23				N/A				N/A				N/A				N/A				N/A	N/A	N/A
	2.02E+08				N/A				N/A				N/A				N/A				N/A	N/A	N/A
		13.47	2.36	432.98		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A			
		0%	0%	0%		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A								
		2.80	0.49	90.00		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A								
		13.47	2.36	432.98		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A								

Step 4 - Pollutant Reduction Met? (For Informational Purposes) 4.1 TMDL (lb/ac/yr) 4.2 Reduction met? 4.3 Final Adjusted Load (lb/yr]		5.70	0.35	N/A																		
		NO	NO	N/A													N/A	N/A	N/A	N/A	N/A	N/A
		1246.15	218.08	40055													N/A	N/A	N/A	N/A	N/A	N/A

PROJECT:	T201609002 I-95 and SR 896 Interchange		
DRAINAGE SUBAREA ID:	Project Level DURMM		
COUNTY:	New Castle	UNIT HYDROGRAPH:	STD
TMDL Watershed:	Christina River	LANDUSE:	#REF!

DURMM OUTPUT WORKSHEET

DURMM v2.51.190603

Site Data

Contributing Area to BMPs (ac.)	92.51			
C.A. RCN	83.86			
Subarea LOD (ac.)	92.51			
Subarea RCN	83.44			
Upstream Subarea ID	N/A	N/A	N/A	N/A
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00
Combined LOD with Upstream Areas (ac.)	92.51			
Combined RCN with Upstream Areas (ac.)	83.44			
Watershed TMDL-TN (lb/ac/yr)	5.70			
Watershed TMDL-TP (lb/ac/yr)	0.35			
Watershed TMDL-TSS (lb/ac/yr)	N/A			

BMP Data

	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
	0-No BMP	--	--	--	--
RPv runoff volume after all reductions (in.)	1.49	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	0.00	N/A	N/A	N/A	N/A
Total RPv runoff reduction (%)	0%	N/A	N/A	N/A	N/A
RPv Compliance Met Through Runoff Reduction?	NO	N/A	N/A	N/A	N/A
RPv Residual Volume (cu. ft.)	41,444	N/A	N/A	N/A	N/A
Adjusted pollutant load, TN (lb/ac/yr)	13.47	N/A	N/A	N/A	N/A
Adjusted pollutant load, TP (lb/ac/yr)	2.36	N/A	N/A	N/A	N/A
Adjusted pollutant load, TSS (lb/ac/yr)	432.98	N/A	N/A	N/A	N/A
Cv runoff volume after all reductions (in.)	3.04	N/A	N/A	N/A	N/A
Fv runoff volume after all reductions (in.)	6.03	N/A	N/A	N/A	N/A

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	1.49	
Annual Runoff for Contributing Area (in.)	21.23	
Req'd RPv to be Managed for Contributing Area (in.)	0.12	
Req'd RPv to be Managed for Contributing Area (%)	8%	
RPv Runoff Management Required (cu. Ft.)	41444	
RPv Runoff Management Provided (cu. Ft.)	0	
RPv Residual Volume (cu.ft.)	41444	SHORTFALL (Requires additional management or offset)
C.A. RPv avg. discharge rate (cfs)	0.24	
C.A. RPv max. discharge rate (cfs)	1.20	
TN Pollutant Load (lb/yr)	1246.15	
TP Pollutant Load (lb/yr)	218.08	
TSS Pollutant Load (lb/yr)	40055	

Conveyance Event (Cv)

Cv runoff volume (in.)	3.04
Adjusted RCN for H&H Modeling (CN*)	83.44

Flooding Event (Fv)

Fv runoff volume (in.)	6.03
Equivalent RCN for H&H Modeling (CN*)	83.44

Adjusted Subarea Data for Downstream DURMM Modeling

Subarea ID	ject Level DURMM
Contributing Area (ac.)	92.51
Weighted Target Runoff (in.)	1.37
Adjusted CN after all reductions	83.44
Adjusted RPv (in.)	1.49
Adjusted Cv (in.)	3.04
Adjusted Fv (in.)	6.03

Adjusted Subarea Data for Nutrient Protocol Modeling

Contributing Area (ac.)	92.51
LOD Area (ac.)	92.51
TN Pollutant Load (lb/yr)	1246.15
TP Pollutant Load (lb/yr)	218.08
TSS Pollutant Load (lb/yr)	40055
Percent Impervious Cover	29%

Adjusted Subarea Data for the Summary Table for Sub-Areas Draining to a Common Point of Interest

Subarea ID	ject Level DURMM	
Contributing Area (ac.)	92.51	
RPv Residual Volume (cu.ft.)	41444	SHORTFALL (Requires additional management or offset)
Adjusted CN after all reductions	83.44	
Cv RCN for H&H Modeling	83.44	
Fv RCN for H&H Modeling	83.44	
TN Pollutant Load (lb/yr)	1246.15	
TP Pollutant Load (lb/yr)	218.08	
TSS Pollutant Load (lb/yr)	40055	

I-95 AND SR 896 INTERCHANGE PROJECT LEVEL DURMM


PRE-DEVELOPMENT



N.T.S.

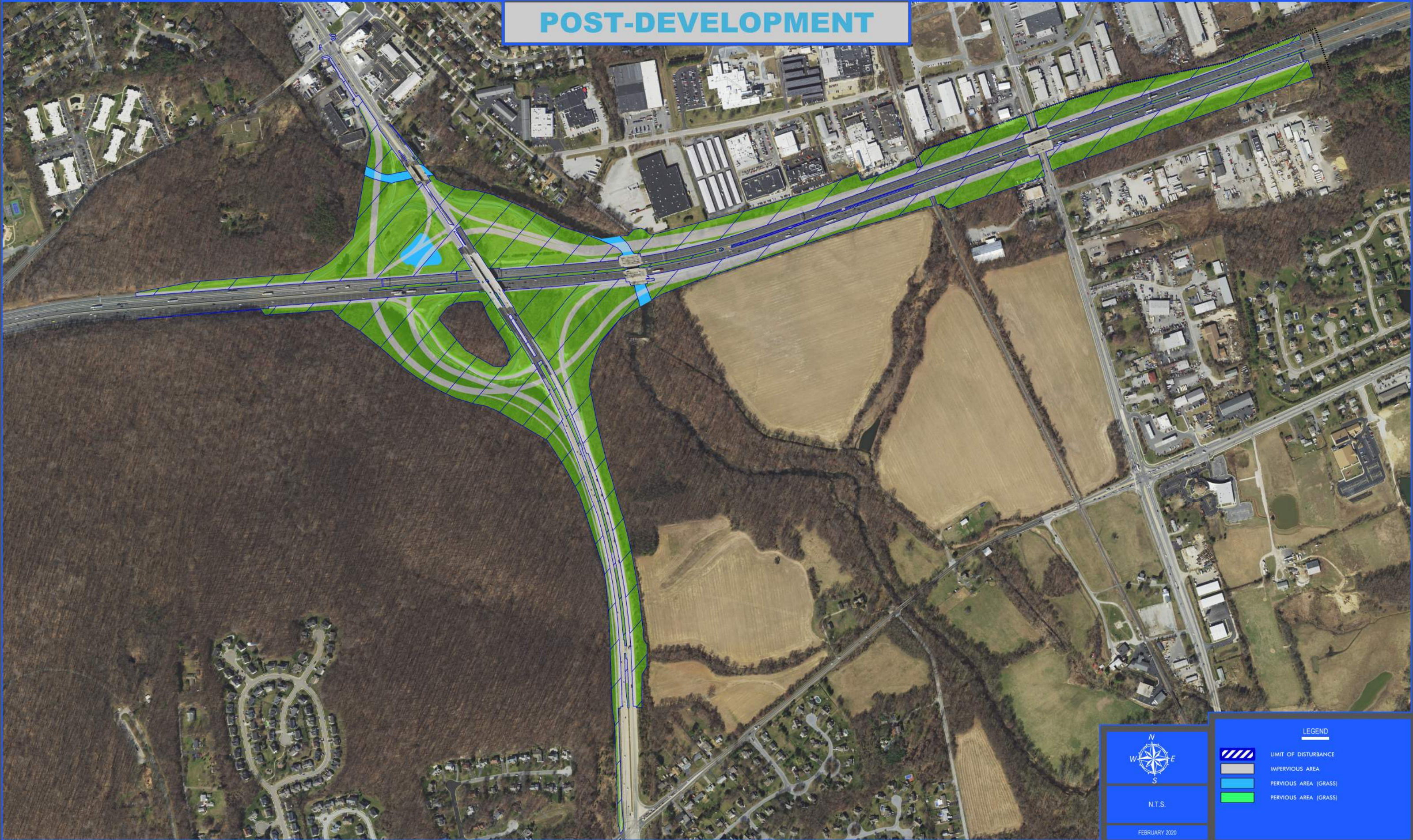
FEBRUARY 2020

LEGEND

-  LIMIT OF DISTURBANCE
-  IMPERVIOUS AREA
-  IMPERVIOUS AREA (WATER)
-  PERVIOUS AREA

I-95 AND SR 896 INTERCHANGE PROJECT LEVEL DURMM

POST-DEVELOPMENT



N
W E
S

N.T.S.

FEBRUARY 2020

LEGEND	
	LIMIT OF DISTURBANCE
	IMPERVIOUS AREA
	PERVIOUS AREA (GRASS)
	PERVIOUS AREA (GRASS)

Appendix E

BMP No. 1XX

PROJECT: T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID: BMP No. 1XX
LOCATION (County): New Castle
UNIT HYDROGRAPH: STD

CONTRIBUTING AREA RUNOFF CURVE NUMBER
(C.A. RCN) WORKSHEET

C.A. RCN) WORKSHEET			Curve Numbers for Hydrologic Soil Type							
Cover Type	Treatment	Hydrologic Condition	A		B		C		D	
			Acres	RCN	Acres	RCN	Acres	RCN	Acres	RCN
CULTIVATED AGRICULTURAL LANDS										
Fallow	Bare soil	----		77		86		91		94
	Crop residue (CR)	poor		76		85		90		93
	Crop residue (CR)	good		74		83		88		90
Row Crops	Straight row (SR)	poor		72		81		88		91
	Straight row (SR)	good		67		78		85		89
	SR + Crop residue	poor		71		80		87		90
	SR + Crop residue	good		64		75		82		85
	Contoured (C)	poor		70		79		84		88
	Contoured (C)	good		65		75		82		86
	C + Crop residue	poor		69		78		83		87
	C + Crop residue	good		64		74		81		85
	Cont & terraced(C&T)	poor		66		74		80		82
	Cont & terraced(C&T)	good		62		71		78		81
Small Grain	C&T + Crop residue	poor		65		73		79		81
	C&T + Crop residue	good		61		70		77		80
	Straight row (SR)	poor		65		76		84		88
	Straight row (SR)	good		63		75		83		87
	SR + Crop residue	poor		64		75		83		86
	SR + Crop residue	good		60		72		80		84
	Contoured (C)	poor		63		74		82		85
	Contoured (C)	good		61		73		81		84
	C + Crop residue	poor		62		73		81		84
	C + Crop residue	good		60		72		80		83
	Cont & terraced(C&T)	poor		61		72		79		82
	Cont & terraced(C&T)	good		59		70		78		81
	C&T + Crop residue	poor		60		71		78		81
	C&T + Crop residue	good		58		69		77		80
	Close-seeded or broadcast legumes or rotation meadow	Straight row	poor		66		77		85	
Straight row		good		58		72		81		85
Contoured		poor		64		75		83		85
Contoured		good		55		69		78		83
Cont & terraced		poor		63		73		80		83
Cont & terraced		good		51		67		76		80

OTHER AGRICULTURAL LANDS										
Pasture, grassland or range		poor		68		79		86		89
		fair		49		69		79		84
		good		39		61		74		80
Meadow -cont. grass (non grazed)		----		30		58		71		78
		poor		48		67		77		83
		fair		35		56		70		77
Brush - brush, weed, grass mix		good		30		48		65		73
		poor		57		73		82		86
		fair		43		65		76		82
Woods - grass combination		good		32		58		72		79
		poor		45		66		77		83
		fair		36		60		73		79
Woods		good		30	41.95	55		70	10.65	77
		----		59		74		82		86

FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns, parks etc.)										
	Poor condition; grass cover < 50%			68		79		86		89
	Fair condition; grass cover 50% to 75 %			49		69		79		84
	Good condition; grass cover > 75%			39		61	0.07	74	2.37	80
Impervious Areas										
	Paved parking lots, roofs, driveways			98		98	0.09	98	11.84	98
	Streets and roads									
	Paved; curbs and storm sewers			98		98		98		98
	Paved; open ditches (w/right-of-way)			83		89		92		93
	Gravel (w/ right-of-way)			76		85		89		91
	Dirt (w/ right-of-way)			72		82		87		89
Urban Districts										
	Commercial & business	Avg % impervious 85		89		92		94		95
	Industrial	72		81		88		91		93
Residential districts by average lot size										
	1/8 acre (town houses)	Avg % impervious 65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82

DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94

USER DEFINED										

Subarea Contributing Area per Soil Type (ac) 0 41.95 0.16 24.86
Subarea Contributing Area (ac) 66.97
Subarea Weighted RCN 67

UPSTREAM CONTRIBUTING AREAS		Subarea ID	Acres	RCN
	Upstream Contributing Area 1			
	Upstream Contributing Area 2			
	Upstream Contributing Area 3			
	Upstream Contributing Area 4			

Total Contributing Area w. Upstream Areas (ac) 67

Weighted Runoff Curve Number (RCN) 67

PROJECT:	T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID:	BMP No. 1XX
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	STD

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data

- 1.1 HSG Area Within LOD (ac)
- 1.2 Pre-Developed Woods/Meadow Within LOD (ac)
- 1.3 Pre-Developed Impervious Within LOD (ac)
- 1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); OR
- 1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)

HSG A	HSG B	HSG C	HSG D
		0.15	4.37
		0	0
		0.03	0.68
		0.07	1.2
0%	0%	47%	27%

Step 2 - Subarea LOD Runoff Calculations

- 2.1 RCN per HSG
- 2.2 RPv per HSG (in.)
- 2.3 Target RCN per HSG
- 2.4 Target Runoff per HSG (in.)

0.00	0.00	85.20	84.94
0.00	0.00	1.57	1.56
0.00	0.00	78.08	82.38
0.00	0.00	1.22	1.42

- 2.5 Subarea LOD (ac)
- 2.6 Subarea Weighted RCN
- 2.7 Subarea Weighted RPv (in.)
- 2.8 Subarea Weighted Target Runoff (in.)

4.52
84.95
1.56
1.41

Step 3 - Upstream LOD Areas (from previous DURMM Report as applicable)

- 3.1 Upstream Sub-Area ID
- 3.2 Upstream Contributing Area (ac)
- 3.3 Target Runoff for Upstream Area (in.)
- 3.4 Adjusted CN after all reductions
- 3.5 Adjusted RPv (in.)
- 3.6 Adjusted Cv (in.)
- 3.7 Adjusted Fv (in.)

Area 1	Area 2	Area 3	Area 4

Step 4 - RPv Calculations for Combined LOD

- 4.1 Combined LOD (ac)
- 4.2 Weighted RCN
- 4.3 Weighted RPv (in.)
- 4.4 Weighted Target Runoff (in.)
- 4.5 Estimated Annual Runoff (in.)
- 4.6 Req'd Runoff to be Managed within LOD (in.)
- 4.7 Req'd Runoff to be Managed within LOD (%)

4.52
84.95
1.56
1.41
22.60
0.14
9%

PROJECT:	T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID:	BMP No. 1XX
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	STD

**OUTSIDE LIMIT OF DISTURBANCE
(OLOD) WORKSHEET**

Step 1 - Site Data

1.1 Total Contributing Area (ac)	66.97
1.2 C.A. RCN	67
1.3 LOD Area (ac)	4.52
1.4 LOD RCN	85
1.5 Outside LOD Area (ac)	62.45
1.6 Outside LOD RCN	66

Step 2 - Time of Concentration

	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
FLOW TYPE						
<i>Sheet</i>				-----	N/A	0.00
				-----	N/A	0.00
				-----	N/A	0.00
<i>Shallow Concentrated</i>				N/A	-----	0.00
				N/A	-----	0.00
				N/A	-----	0.00
<i>Open Channel</i>			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
2.7 Time of Concentration (Tc)						0.10

Sheet Flow Surface Codes

a smooth surface	f grass, dense
b fallow (no residue)	g grass, bermuda
c cultivated < 20% Res.	h woods, light
d cultivated > 20% Res.	i woods, dense
e grass - range, short	j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

3.1 Unit Hydrograph Type	STD	
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	1.077	1.077
3.5 Ia/P ratio	0.22	0.13
3.6 Unit Peak Discharge, qu (csm/in)	1030	1034
3.7 Runoff (in.)	1.58	3.98
3.8 Peak Discharge, qp (cfs)	158.49	401.65
3.9 Equiv. unit peak discharge (cfs/ac)	2.54	6.43

PROJECT: T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID: BMP No. 1XX
LOCATION (County): New Castle

RESOURCE PROTECTION EVENT (RPv) WORKSHEET

Step 1 - Calculate Initial RPv

- 1.1 Total contributing area to BMP (ac)
- 1.2 Initial RCN
- 1.3 RPv for Contributing Area (in.)
- 1.4 Req'd RPv to be Managed for Contributing Area (in.)
- 1.5 Req'd RPv to be Managed for Contributing Area (%)

BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
Type	13-B Wet Extended Detention (ED) Pond	Type	--	Type	--	Type	--	Type	--
Data									
66.97									
67.06									
0.82									
0.01									
1%									

Step 2 - Adjust for Retention Reduction

- 2.1 Retention volume provided (cu. ft.)
- 2.2 Retention reduction allowance (%)
- 2.3 Retention reduction volume (ac-ft)
- 2.4 Retention reduction volume (in.)
- 2.5 Runoff volume after retention reduction (in.)
- 2.6 Adjusted CN*

0%		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
0.82		N/A		N/A		N/A		N/A	
67.06		N/A		N/A		N/A		N/A	

Step 3 - Adjust for Annual Runoff Reduction

- 3.1 Annual CN (ACN)
- 3.2 Annual runoff (in.)
- 3.3 Proportion A/B soils in BMP footprint (%)
- 3.4 Annual runoff reduction allowance (%)
- 3.5 Annual runoff after reduction (in.)
- 3.6 Adjusted ACN
- 3.7 Annual Runoff Reduction Allowance for RPv (in.)

67.06		N/A		N/A		N/A		N/A	
9.88		N/A		N/A		N/A		N/A	
0%		0%		0%		0%		0%	
0%		N/A		N/A		N/A		N/A	
9.88		N/A		N/A		N/A		N/A	
67.06		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	

Step 4 - Calculate RPv with BMP Reductions

- 4.1 RPv Runoff Manangement Provided (cu. ft.)
- 4.2 RPv runoff volume after all reductions (in.)
- 4.3 RPv runoff volume after all reductions (cu.ft.)
- 4.4 Total RPv runoff reduction (in.)
- 4.5 Total RPv runoff reduction (%)
- 4.6 Adjusted CN after all reductions*
- 4.7 Adjusted equivalent annual runoff (in.)
- 4.8 RPv Compliance Met Through Runoff Reduction?
- 4.9 Runoff Reduction Credit, if Applicable (cu.ft)

0		N/A		N/A		N/A		N/A	
0.82		N/A		N/A		N/A		N/A	
198,826		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
0%		N/A		N/A		N/A		N/A	
67.06		N/A		N/A		N/A		N/A	
9.88		N/A		N/A		N/A		N/A	
NO		N/A		N/A		N/A		N/A	
N/A		N/A		N/A		N/A		N/A	

Step 5 - Determine Residual Volume to be Managed or Offset

- 5.1 RPv Residual Volume (in.)
- 5.2 RPv Residual Volume (cu.ft./ac)
- 5.3 Residual Volume to be Managed or Offset (cu.ft.)
- 5.4 RPv avg. discharge rate for 48-hr detention (cfs)
- 5.5 RPv max. discharge rate for 48-hr detention (cfs)

0.01		N/A		N/A		N/A		N/A	
35		N/A		N/A		N/A		N/A	
2,323		N/A		N/A		N/A		N/A	
0.013		N/A		N/A		N/A		N/A	
0.067		N/A		N/A		N/A		N/A	

*NOTE: No additional runoff reduction credit can be taken for surface recharge practices once the "Adjusted CN after all reductions" (Step 4.6) reaches the equivalent CN for the native soil-cover condition of the BMP footprint itself (i.e. for Sheet Flow to Turf Filter Strip on B soils Step 4.6 cannot be below 61). If this occurs contact the DNREC – SSP for further guidance

PROJECT:	T201609002 I-95 and SR 896 Interchange											
DRAINAGE SUBAREA ID:	BMP No. 1XX											
TMDL WATERSHED:	Christina River											

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

	BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
	Type:	13-B Wet Extended Detention (ED) Pond			Type:	--			Type:	--			Type:	--			Type:	--		
	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
	66.97																			
1.1 Total contributing area to BMP (ac)	67																			
1.2 Initial RCN	9.88																			
1.3 Annual runoff volume (in.)	6.80E+07																			
1.4 Annual runoff volume (liters)																				

Step 2 - Calculate Annual Pollutant Load

2.1 EMC (mg/L)	2.80	0.49	90		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
2.2 Load (mg/yr)	1.90E+08	3.33E+07	6.12E+09		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
2.3 Stormwater Load (lb/ ac/yr)	6.27	1.10	201.54		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A

Step 3 - Adjust for Pollutant Reduction

3.1 BMP annual runoff reduction (%)	0%				N/A				N/A				N/A				N/A			
3.2 Adjusted annual runoff volume (in)	9.88				N/A				N/A				N/A							
3.3 Adjusted annual runoff volume (liters)	6.80E+07				N/A				N/A				N/A							
3.4 Adjusted load from annual reductions (lb/ac/yr)	6.27	1.10	201.54		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A	
3.5 BMP removal efficiency (%)	30%	55%	60%		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A	
3.6 BMP effluent concentration (mg/L)	1.96	0.22	36.00		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A	
3.7 Final Adjusted load (lb/ ac/yr)	4.39	0.49	80.62		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A	

Step 4 - Pollutant Reduction Met? (For Informational Purposes)

4.1 TMDL (lb/ ac/yr)	5.70	0.35	N/A																
4.2 Reduction met?	YES	NO	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
4.3 Final Adjusted Load (lb/yr)	293.93	33.07	5399		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A

PROJECT:	T201609002 I-95 and SR 896 Interchange		
DRAINAGE SUBAREA ID:	BMP No. 1XX		
COUNTY:	New Castle	UNIT HYDROGRAPH:	STD
TMDL Watershed:	Christina River	LANDUSE:	#REF!

DURMM OUTPUT WORKSHEET

DURMM v2.51.190603

Site Data

Contributing Area to BMPs (ac.)	66.97				
C.A. RCN	67.06				
Subarea LOD (ac.)	4.52				
Subarea RCN	84.95				
Upstream Subarea ID	N/A	N/A	N/A	N/A	
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	4.52				
Combined RCN with Upstream Areas (ac.)	84.95				
Watershed TMDL-TN (lb/ac/yr)	5.70				
Watershed TMDL-TP (lb/ac/yr)	0.35				
Watershed TMDL-TSS (lb/ac/yr)	N/A				

BMP Data

BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
13-B Wet Extended Detention (ED) Pond	--	--	--	--
RPv runoff volume after all reductions (in.)	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	0.00	N/A	N/A	N/A
Total RPv runoff reduction (%)	0%	N/A	N/A	N/A
RPv Compliance Met Through Runoff Reduction?	NO	N/A	N/A	N/A
RPv Residual Volume (cu. ft.)	2,323	N/A	N/A	N/A
Adjusted pollutant load, TN (lb/ac/yr)	4.39	N/A	N/A	N/A
Adjusted pollutant load, TP (lb/ac/yr)	0.49	N/A	N/A	N/A
Adjusted pollutant load, TSS (lb/ac/yr)	80.62	N/A	N/A	N/A
Cv runoff volume after all reductions (in.)	1.67	N/A	N/A	N/A
Fv runoff volume after all reductions (in.)	4.13	N/A	N/A	N/A

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	0.82	
Annual Runoff for Contributing Area (in.)	9.88	
Req'd RPv to be Managed for Contributing Area (in.)	0.01	
Req'd RPv to be Managed for Contributing Area (%)	1%	
RPv Runoff Management Required (cu. Ft.)	2323	
RPv Runoff Management Provided (cu. Ft.)	0	
RPv Residual Volume (cu.ft.)	2323	SHORTFALL (Requires additional management or offset)
C.A. RPv avg. discharge rate (cfs)	0.01	
C.A. RPv max. discharge rate (cfs)	0.07	
TN Pollutant Load (lb/yr)	293.93	
TP Pollutant Load (lb/yr)	33.07	
TSS Pollutant Load (lb/yr)	5399	

Conveyance Event (Cv)

Cv runoff volume (in.)	1.67
Adjusted RCN for H&H Modeling (CN*)	67.06

Flooding Event (Fv)

Fv runoff volume (in.)	4.13
Equivalent RCN for H&H Modeling (CN*)	67.06

Adjusted Subarea Data for Downstream DURMM Modeling

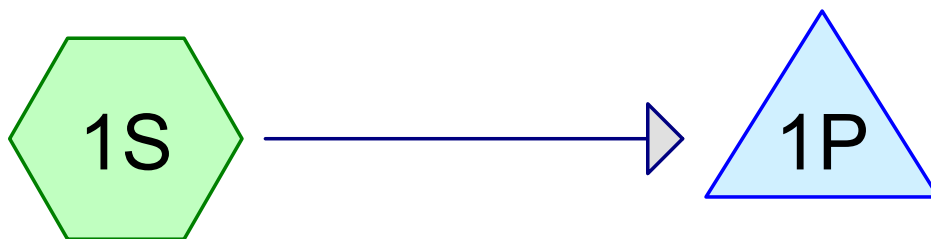
Subarea ID	BMP No. 1XX
Contributing Area (ac.)	66.97
Weighted Target Runoff (in.)	1.41
Adjusted CN after all reductions	67.06
Adjusted RPv (in.)	0.82
Adjusted Cv (in.)	1.67
Adjusted Fv (in.)	4.13

Adjusted Subarea Data for Nutrient Protocol Modeling

Contributing Area (ac.)	66.97
LOD Area (ac.)	4.52
TN Pollutant Load (lb/yr)	293.93
TP Pollutant Load (lb/yr)	33.07
TSS Pollutant Load (lb/yr)	5399
Percent Impervious Cover	28%

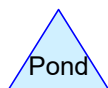
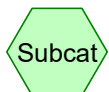
Adjusted Subarea Data for the Summary Table for Sub-Areas Draining to a Common Point of Interest

Subarea ID	BMP No. 1XX	
Contributing Area (ac.)	66.97	
RPv Residual Volume (cu.ft.)	2323	SHORTFALL (Requires additional management or offset)
Adjusted CN after all reductions	67.06	
Cv RCN for H&H Modeling	67.06	
Fv RCN for H&H Modeling	67.06	
TN Pollutant Load (lb/yr)	293.93	
TP Pollutant Load (lb/yr)	33.07	
TSS Pollutant Load (lb/yr)	5399	



DA to BMP No. 1XX

BMP No. 1XX



CONCEPT DESIGN

Drainage Diagram for I95&SR896 Preliminary SWM

Prepared by CEI, Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

I95&SR896 Preliminary SWM*Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05*

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 2

Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1S: DA to BMP No. 1XX Runoff Area=66.970 ac 17.81% Impervious Runoff Depth=0.82"
Flow Length=3,110' Tc=35.3 min CN=67 Runoff=39.29 cfs 4.554 af

Pond 1P: BMP No. 1XX Peak Elev=70.41' Storage=293,502 cf Inflow=39.29 cfs 4.554 af
Outflow=0.07 cfs 0.363 af

Total Runoff Area = 66.970 ac Runoff Volume = 4.554 af Average Runoff Depth = 0.82"
82.19% Pervious = 55.040 ac 17.81% Impervious = 11.930 ac

I95&SR896 Preliminary SWM

Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 3

Summary for Subcatchment 1S: DA to BMP No. 1XX

Runoff = 39.29 cfs @ 12.32 hrs, Volume= 4.554 af, Depth= 0.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

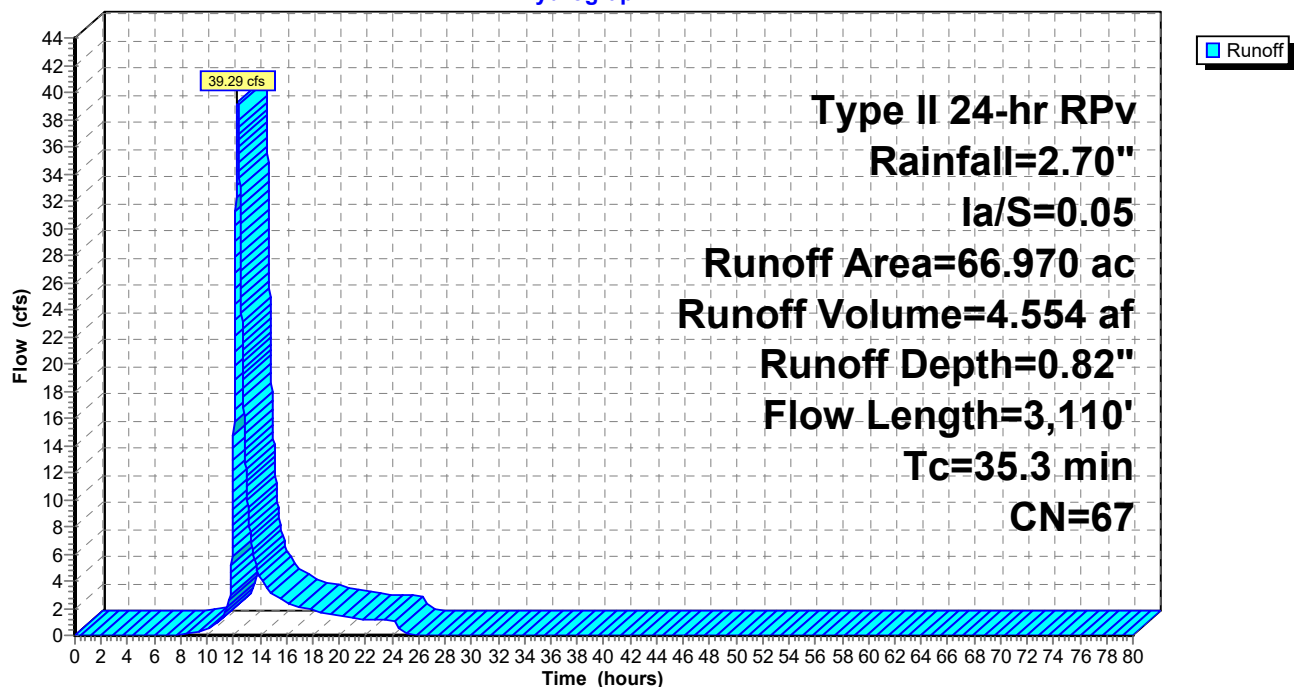
Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05

Area (ac)	CN	Description
0.090	98	Paved roads w/curbs & sewers, HSG C
11.840	98	Paved roads w/curbs & sewers, HSG D
0.070	74	>75% Grass cover, Good, HSG C
2.370	80	>75% Grass cover, Good, HSG D
41.950	55	Woods, Good, HSG B
10.650	77	Woods, Good, HSG D
66.970	67	Weighted Average
55.040		82.19% Pervious Area
11.930		17.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.0	100	0.0300	0.09		Sheet Flow, Sheet Flow Woods: Light underbrush n= 0.400 P2= 3.30"
13.0	1,227	0.0986	1.57		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.2	1,322	0.0877	6.96	13.91	Trap/Vee/Rect Channel Flow, Bot.W=2.00' D=0.50' Z= 4.0 '/' Top.W=6.00' n= 0.030 Earth, grassed & winding
0.2	222	0.0221	18.41	231.34	Pipe Channel, 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.012 Concrete pipe, finished
0.8	119	0.0200	2.58	1.29	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=0.50' Z= 2.0 '/' Top.W=2.00' n= 0.030 Earth, grassed & winding
0.1	120	0.0520	28.24	354.85	Pipe Channel, 48.0" Round Area= 12.6 sf Perim= 12.6' r= 1.00' n= 0.012 Concrete pipe, finished
35.3	3,110	Total			

Subcatchment 1S: DA to BMP No. 1XX

Hydrograph



I95&SR896 Preliminary SWM

Prepared by CEI

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Type II 24-hr R_{Pv} Rainfall=2.70", I_a/S=0.05

Printed 2/10/2020

Page 5

Hydrograph for Subcatchment 1S: DA to BMP No. 1XX

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	52.00	2.70	0.82	0.00
1.00	0.03	0.00	0.00	53.00	2.70	0.82	0.00
2.00	0.06	0.00	0.00	54.00	2.70	0.82	0.00
3.00	0.09	0.00	0.00	55.00	2.70	0.82	0.00
4.00	0.13	0.00	0.00	56.00	2.70	0.82	0.00
5.00	0.17	0.00	0.00	57.00	2.70	0.82	0.00
6.00	0.22	0.00	0.00	58.00	2.70	0.82	0.00
7.00	0.27	0.00	0.00	59.00	2.70	0.82	0.00
8.00	0.32	0.00	0.07	60.00	2.70	0.82	0.00
9.00	0.40	0.00	0.21	61.00	2.70	0.82	0.00
10.00	0.49	0.01	0.44	62.00	2.70	0.82	0.00
11.00	0.63	0.03	1.08	63.00	2.70	0.82	0.00
12.00	1.79	0.37	12.93	64.00	2.70	0.82	0.00
13.00	2.08	0.50	10.90	65.00	2.70	0.82	0.00
14.00	2.21	0.56	4.31	66.00	2.70	0.82	0.00
15.00	2.30	0.61	3.07	67.00	2.70	0.82	0.00
16.00	2.38	0.64	2.48	68.00	2.70	0.82	0.00
17.00	2.43	0.67	2.06	69.00	2.70	0.82	0.00
18.00	2.49	0.70	1.85	70.00	2.70	0.82	0.00
19.00	2.53	0.72	1.63	71.00	2.70	0.82	0.00
20.00	2.57	0.75	1.40	72.00	2.70	0.82	0.00
21.00	2.60	0.76	1.26	73.00	2.70	0.82	0.00
22.00	2.64	0.78	1.22	74.00	2.70	0.82	0.00
23.00	2.67	0.80	1.18	75.00	2.70	0.82	0.00
24.00	2.70	0.82	1.13	76.00	2.70	0.82	0.00
25.00	2.70	0.82	0.07	77.00	2.70	0.82	0.00
26.00	2.70	0.82	0.00	78.00	2.70	0.82	0.00
27.00	2.70	0.82	0.00	79.00	2.70	0.82	0.00
28.00	2.70	0.82	0.00	80.00	2.70	0.82	0.00
29.00	2.70	0.82	0.00				
30.00	2.70	0.82	0.00				
31.00	2.70	0.82	0.00				
32.00	2.70	0.82	0.00				
33.00	2.70	0.82	0.00				
34.00	2.70	0.82	0.00				
35.00	2.70	0.82	0.00				
36.00	2.70	0.82	0.00				
37.00	2.70	0.82	0.00				
38.00	2.70	0.82	0.00				
39.00	2.70	0.82	0.00				
40.00	2.70	0.82	0.00				
41.00	2.70	0.82	0.00				
42.00	2.70	0.82	0.00				
43.00	2.70	0.82	0.00				
44.00	2.70	0.82	0.00				
45.00	2.70	0.82	0.00				
46.00	2.70	0.82	0.00				
47.00	2.70	0.82	0.00				
48.00	2.70	0.82	0.00				
49.00	2.70	0.82	0.00				
50.00	2.70	0.82	0.00				
51.00	2.70	0.82	0.00				

I95&SR896 Preliminary SWMType II 24-hr R_{Pv} Rainfall=2.70", I_a/S=0.05

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 6

Summary for Pond 1P: BMP No. 1XX

Inflow Area = 66.970 ac, 17.81% Impervious, Inflow Depth = 0.82" for R_{Pv} event
 Inflow = 39.29 cfs @ 12.32 hrs, Volume= 4.554 af
 Outflow = 0.07 cfs @ 25.01 hrs, Volume= 0.363 af, Atten= 100%, Lag= 761.4 min
 Primary = 0.07 cfs @ 25.01 hrs, Volume= 0.363 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Starting Elev= 66.00' Surf.Area= 33,281 sf Storage= 98,091 cf
 Peak Elev= 70.41' @ 25.01 hrs Surf.Area= 51,649 sf Storage= 293,502 cf (195,411 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= 1,906.0 min (2,773.3 - 867.3)

Volume	Invert	Avail.Storage	Storage Description
#1	62.00'	500,331 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
62.00	19,368	0	0
63.00	21,066	20,217	20,217
64.00	22,828	21,947	42,164
65.00	24,648	23,738	65,902
65.01	31,184	279	66,181
66.00	33,281	31,910	98,091
67.00	35,440	34,361	132,452
67.01	43,095	393	132,845
68.00	45,527	43,868	176,712
69.00	48,025	46,776	223,488
70.00	50,586	49,306	272,794
71.00	53,211	51,899	324,692
72.00	55,900	54,556	379,248
73.00	58,652	57,276	436,524
74.00	68,963	63,808	500,331

Device	Routing	Invert	Outlet Devices
#1	Primary	66.00'	48.0" Round Culvert L= 85.1' Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 63.00' S= 0.0353 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished
#2	Device 1	66.00'	1.1" Vert. Orifice/Grate C= 0.600
#3	Device 1	71.00'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Head (feet) 0.00 2.00 Width (feet) 5.00 5.00
#4	Device 1	73.00'	30.0" x 66.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

I95&SR896 Preliminary SWM

Prepared by CEI

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05

Printed 2/10/2020

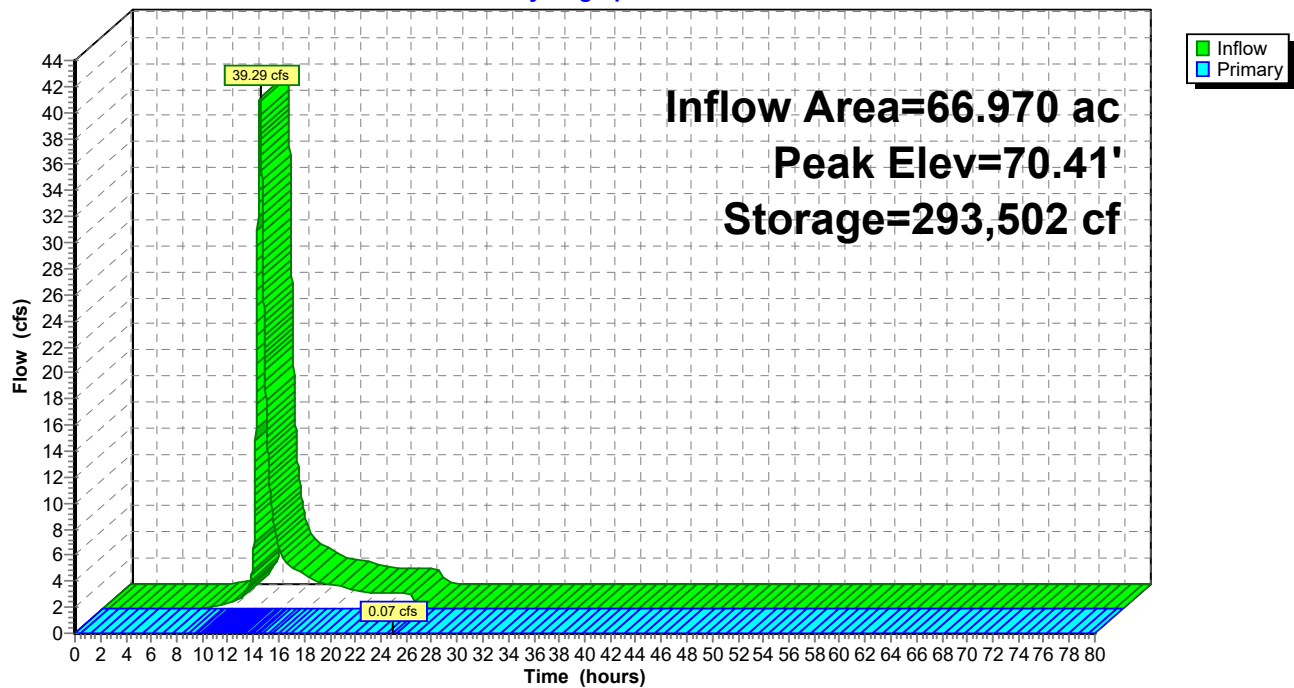
Page 7

Primary OutFlow Max=0.07 cfs @ 25.01 hrs HW=70.41' (Free Discharge)

- 1=Culvert (Passes 0.07 cfs of 93.84 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.07 cfs @ 10.05 fps)
- 3=Custom Weir/Orifice (Controls 0.00 cfs)
- 4=Orifice/Grate (Controls 0.00 cfs)

Pond 1P: BMP No. 1XX

Hydrograph



I95&SR896 Preliminary SWM*Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05*

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 8

Hydrograph for Pond 1P: BMP No. 1XX

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	98,091	66.00	0.00
2.00	0.00	98,091	66.00	0.00
4.00	0.00	98,091	66.00	0.00
6.00	0.00	98,091	66.00	0.00
8.00	0.07	98,206	66.00	0.00
10.00	0.44	99,824	66.05	0.00
12.00	12.93	112,883	66.44	0.02
14.00	4.31	226,578	69.06	0.06
16.00	2.48	248,932	69.52	0.06
18.00	1.85	263,574	69.82	0.06
20.00	1.40	274,851	70.04	0.06
22.00	1.22	283,577	70.21	0.06
24.00	1.13	291,584	70.37	0.07
26.00	0.00	293,319	70.40	0.07
28.00	0.00	292,842	70.39	0.07
30.00	0.00	292,365	70.38	0.07
32.00	0.00	291,889	70.37	0.07
34.00	0.00	291,413	70.36	0.07
36.00	0.00	290,938	70.36	0.07
38.00	0.00	290,463	70.35	0.07
40.00	0.00	289,989	70.34	0.07
42.00	0.00	289,515	70.33	0.07
44.00	0.00	289,042	70.32	0.07
46.00	0.00	288,569	70.31	0.07
48.00	0.00	288,097	70.30	0.07
50.00	0.00	287,626	70.29	0.07
52.00	0.00	287,154	70.28	0.07
54.00	0.00	286,684	70.27	0.07
56.00	0.00	286,214	70.26	0.07
58.00	0.00	285,744	70.25	0.07
60.00	0.00	285,275	70.25	0.07
62.00	0.00	284,806	70.24	0.07
64.00	0.00	284,338	70.23	0.06
66.00	0.00	283,871	70.22	0.06
68.00	0.00	283,404	70.21	0.06
70.00	0.00	282,937	70.20	0.06
72.00	0.00	282,471	70.19	0.06
74.00	0.00	282,006	70.18	0.06
76.00	0.00	281,541	70.17	0.06
78.00	0.00	281,076	70.16	0.06
80.00	0.00	280,612	70.15	0.06

Appendix F

BMP No. 2XX

PROJECT: T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID: BMP No. 2XX
LOCATION (County): New Castle
UNIT HYDROGRAPH: STD

CONTRIBUTING AREA RUNOFF CURVE NUMBER
(C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type							
			A		B		C		D	
			Acres	RCN	Acres	RCN	Acres	RCN	Acres	RCN
CULTIVATED AGRICULTURAL LANDS										
Fallow	Bare soil	----		77		86		91		94
	Crop residue (CR)	poor		76		85		90		93
	Crop residue (CR)	good		74		83		88		90
Row Crops	Straight row (SR)	poor		72		81		88		91
	Straight row (SR)	good		67		78		85		89
	SR + Crop residue	poor		71		80		87		90
	SR + Crop residue	good		64		75		82		85
	Contoured (C)	poor		70		79		84		88
	Contoured (C)	good		65		75		82		86
	C + Crop residue	poor		69		78		83		87
	C + Crop residue	good		64		74		81		85
	Cont & terraced(C&T)	poor		66		74		80		82
	Cont & terraced(C&T)	good		62		71		78		81
Small Grain	C&T + Crop residue	poor		65		73		79		81
	C&T + Crop residue	good		61		70		77		80
	Straight row (SR)	poor		65		76		84		88
	Straight row (SR)	good		63		75		83		87
	SR + Crop residue	poor		64		75		83		86
	SR + Crop residue	good		60		72		80		84
	Contoured (C)	poor		63		74		82		85
	Contoured (C)	good		61		73		81		84
	C + Crop residue	poor		62		73		81		84
	C + Crop residue	good		60		72		80		83
Close-seeded or broadcast legumes or rotation meadow	Cont & terraced(C&T)	poor		61		72		79		82
	Cont & terraced(C&T)	good		59		70		78		81
	C&T + Crop residue	poor		60		71		78		81
	C&T + Crop residue	good		58		69		77		80
	Straight row	poor		66		77		85		89
	Straight row	good		58		72		81		85
	Contoured	poor		64		75		83		86
	Contoured	good		55		69		78		83
	Cont & terraced	poor		63		73		80		83
	Cont & terraced	good		51		67		76		80
OTHER AGRICULTURAL LANDS										
Pasture, grassland or range	poor		68		79		86		89	
	fair		49		69		79		84	
	good		39		61		74		80	
Meadow -cont. grass (non grazed)	----		30		58		71		78	
	poor		48		67		77		83	
	fair		35		56		70		77	
Brush - brush, weed, grass mix	good		30		48		65		73	
	poor		57		73		82		86	
	fair		43		65		76		82	
Woods - grass combination	good		32		58		72		79	
	poor		45		66		77		83	
	fair		36		60		73		79	
Woods	poor		30		55		70		77	
	fair		36		60		73		79	
	good		30		55		70		77	
Farmsteads	----		59		74		82		86	
FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns,parks etc.)	Poor condition; grass cover < 50%		68		79		86		89	
	Fair condition; grass cover 50% to 75 %		49		69		79		84	
	Good condition; grass cover > 75%		39		61		74	2.1	80	
Impervious Areas	Paved parking lots, roofs, driveways		98		98		98	2	98	
	Streets and roads									
	Paved; curbs and storm sewers		98		98		98		98	
	Paved; open ditches (w/right-of-way)		83		89		92		93	
	Gravel (w/ right-of-way)		76		85		89		91	
	Dirt (w/ right-of-way)		72		82		87		89	
Urban Districts	Avg % impervious									
	Commercial & business	85		89		92		94		95
Industrial	72		81		88		91		93	
	Residential districts by average lot size	Avg % impervious								
1/8 acre (town houses)	65		77		85		90		92	
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)										
Newly graded area (pervious only)			77		86		91		94	
USER DEFINED										
Subarea Contributing Area per Soil Type (ac)			0	0	0	4.1				
Subarea Contributing Area (ac)			4.1							
Subarea Weighted RCN			89							
UPSTREAM CONTRIBUTING AREAS										
Subarea ID	Acres	RCN								
Upstream Contributing Area 1										
Upstream Contributing Area 2										
Upstream Contributing Area 3										
Upstream Contributing Area 4										
Total Contributing Area w. Upstream Areas (ac)			4.1							
Weighted Runoff Curve Number (RCN)			89							

PROJECT:	T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID:	BMP No. 2XX
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	STD

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data

- 1.1 HSG Area Within LOD (ac)
- 1.2 Pre-Developed Woods/Meadow Within LOD (ac)
- 1.3 Pre-Developed Impervious Within LOD (ac)
- 1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); OR
- 1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)

HSG A	HSG B	HSG C	HSG D
			2.54
			0
			0.62
			0.7
0%	0%	0%	28%

Step 2 - Subarea LOD Runoff Calculations

- 2.1 RCN per HSG
- 2.2 RPv per HSG (in.)
- 2.3 Target RCN per HSG
- 2.4 Target Runoff per HSG (in.)

0.00	0.00	0.00	84.96
0.00	0.00	0.00	1.56
0.00	0.00	0.00	83.73
0.00	0.00	0.00	1.49

- 2.5 Subarea LOD (ac)
- 2.6 Subarea Weighted RCN
- 2.7 Subarea Weighted RPv (in.)
- 2.8 Subarea Weighted Target Runoff (in.)

2.54
84.96
1.56
1.49

Step 3 - Upstream LOD Areas (from previous DURMM Report as applicable)

- 3.1 Upstream Sub-Area ID
- 3.2 Upstream Contributing Area (ac)
- 3.3 Target Runoff for Upstream Area (in.)
- 3.4 Adjusted CN after all reductions
- 3.5 Adjusted RPv (in.)
- 3.6 Adjusted Cv (in.)
- 3.7 Adjusted Fv (in.)

Area 1	Area 2	Area 3	Area 4

Step 4 - RPv Calculations for Combined LOD

- 4.1 Combined LOD (ac)
- 4.2 Weighted RCN
- 4.3 Weighted RPv (in.)
- 4.4 Weighted Target Runoff (in.)
- 4.5 Estimated Annual Runoff (in.)
- 4.6 Req'd Runoff to be Managed within LOD (in.)
- 4.7 Req'd Runoff to be Managed within LOD (%)

2.54
84.96
1.56
1.49
22.61
0.07
4%

PROJECT:	T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID:	BMP No. 2XX
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	STD

**OUTSIDE LIMIT OF DISTURBANCE
(OLOD) WORKSHEET**

Step 1 - Site Data

1.1 Total Contributing Area (ac)	4.1
1.2 C.A. RCN	89
1.3 LOD Area (ac)	2.54
1.4 LOD RCN	85
1.5 Outside LOD Area (ac)	1.56
1.6 Outside LOD RCN	95

Step 2 - Time of Concentration

	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
FLOW TYPE						
<i>Sheet</i>				-----	N/A	0.00
				-----	N/A	0.00
				-----	N/A	0.00
<i>Shallow Concentrated</i>				N/A	-----	0.00
				N/A	-----	0.00
				N/A	-----	0.00
<i>Open Channel</i>			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
2.7 Time of Concentration (Tc)						0.10

Sheet Flow Surface Codes

a smooth surface	f grass, dense
b fallow (no residue)	g grass, bermuda
c cultivated < 20% Res.	h woods, light
d cultivated > 20% Res.	i woods, dense
e grass - range, short	j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

3.1 Unit Hydrograph Type	STD	
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	0.105	0.105
3.5 Ia/P ratio	0.02	0.01
3.6 Unit Peak Discharge, qu (csm/in)	855	831
3.7 Runoff (in.)	4.22	7.40
3.8 Peak Discharge, qp (cfs)	8.80	15.00
3.9 Equiv. unit peak discharge (cfs/ac)	5.64	9.61

PROJECT: T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID: BMP No. 2XX
LOCATION (County): New Castle

RESOURCE PROTECTION EVENT (RPv) WORKSHEET

Step 1 - Calculate Initial RPv

- 1.1 Total contributing area to BMP (ac)
- 1.2 Initial RCN
- 1.3 RPv for Contributing Area (in.)
- 1.4 Req'd RPv to be Managed for Contributing Area (in.)
- 1.5 Req'd RPv to be Managed for Contributing Area (%)

BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
Type	13-B Wet Extended Detention (ED) Pond	Type	--	Type	--	Type	--	Type	--
Data									
4.10									
88.78									
1.78									
0.04									
2%									

Step 2 - Adjust for Retention Reduction

- 2.1 Retention volume provided (cu. ft.)
- 2.2 Retention reduction allowance (%)
- 2.3 Retention reduction volume (ac-ft)
- 2.4 Retention reduction volume (in.)
- 2.5 Runoff volume after retention reduction (in.)
- 2.6 Adjusted CN*

0%		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
1.78		N/A		N/A		N/A		N/A	
88.78		N/A		N/A		N/A		N/A	

Step 3 - Adjust for Annual Runoff Reduction

- 3.1 Annual CN (ACN)
- 3.2 Annual runoff (in.)
- 3.3 Proportion A/B soils in BMP footprint (%)
- 3.4 Annual runoff reduction allowance (%)
- 3.5 Annual runoff after reduction (in.)
- 3.6 Adjusted ACN
- 3.7 Annual Runoff Reduction Allowance for RPv (in.)

88.78		N/A		N/A		N/A		N/A	
26.37		N/A		N/A		N/A		N/A	
0%		0%		0%		0%		0%	
0%		N/A		N/A		N/A		N/A	
26.37		N/A		N/A		N/A		N/A	
88.78		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	

Step 4 - Calculate RPv with BMP Reductions

- 4.1 RPv Runoff Manangement Provided (cu. ft.)
- 4.2 RPv runoff volume after all reductions (in.)
- 4.3 RPv runoff volume after all reductions (cu.ft.)
- 4.4 Total RPv runoff reduction (in.)
- 4.5 Total RPv runoff reduction (%)
- 4.6 Adjusted CN after all reductions*
- 4.7 Adjusted equivalent annual runoff (in.)
- 4.8 RPv Compliance Met Through Runoff Reduction?
- 4.9 Runoff Reduction Credit, if Applicable (cu.ft)

0		N/A		N/A		N/A		N/A	
1.78		N/A		N/A		N/A		N/A	
26,529		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
0%		N/A		N/A		N/A		N/A	
88.78		N/A		N/A		N/A		N/A	
26.37		N/A		N/A		N/A		N/A	
NO		N/A		N/A		N/A		N/A	
N/A		N/A		N/A		N/A		N/A	

Step 5 - Determine Residual Volume to be Managed or Offset

- 5.1 RPv Residual Volume (in.)
- 5.2 RPv Residual Volume (cu.ft./ac)
- 5.3 Residual Volume to be Managed or Offset (cu.ft.)
- 5.4 RPv avg. discharge rate for 48-hr detention (cfs)
- 5.5 RPv max. discharge rate for 48-hr detention (cfs)

0.04		N/A		N/A		N/A		N/A	
148		N/A		N/A		N/A		N/A	
608		N/A		N/A		N/A		N/A	
0.004		N/A		N/A		N/A		N/A	
0.018		N/A		N/A		N/A		N/A	

*NOTE: No additional runoff reduction credit can be taken for surface recharge practices once the "Adjusted CN after all reductions" (Step 4.6) reaches the equivalent CN for the native soil-cover condition of the BMP footprint itself (i.e. for Sheet Flow to Turf Filter Strip on B soils Step 4.6 cannot be below 61). If this occurs contact the DNREC – SSP for further guidance

PROJECT:	T201609002 I-95 and SR 896 Interchange											
DRAINAGE SUBAREA ID:	BMP No. 2XX											
TMDL WATERSHED:	Christina River											

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

	BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
	Type:	13-B Wet Extended Detention (ED) Pond			Type:	--			Type:	--			Type:	--			Type:	--		
	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
	4.10																			
1.1 Total contributing area to BMP (ac)	89																			
1.2 Initial RCN	26.37																			
1.3 Annual runoff volume (in.)	1.11E+07																			
1.4 Annual runoff volume (liters)																				

Step 2 - Calculate Annual Pollutant Load

2.1 EMC (mg/L)	2.80	0.49	90		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
2.2 Load (mg/yr)	3.11E+07	5.45E+06	1.00E+09		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
2.3 Stormwater Load (lb/ ac/yr)	16.74	2.93	537.99		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A

Step 3 - Adjust for Pollutant Reduction

3.1 BMP annual runoff reduction (%)	0%			N/A			N/A			N/A			N/A			N/A		
3.2 Adjusted annual runoff volume (in)	26.37			N/A			N/A			N/A			N/A			N/A		
3.3 Adjusted annual runoff volume (liters)	1.11E+07			N/A			N/A			N/A			N/A			N/A		
3.4 Adjusted load from annual reductions (lb/ac/yr)	16.74			2.93			537.99			N/A			N/A			N/A		
3.5 BMP removal efficiency (%)	30%			55%			60%			N/A			N/A			N/A		
3.6 BMP effluent concentration (mg/L)	1.96			0.22			36.00			N/A			N/A			N/A		
3.7 Final Adjusted load (lb/ ac/yr)	11.72			1.32			215.20			N/A			N/A			N/A		

Step 4 - Pollutant Reduction Met? (For Informational Purposes)

4.1 TMDL (lb/ac/yr)	5.70	0.35	N/A																
4.2 Reduction met?	NO	NO	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
4.3 Final Adjusted Load (lb/yr)	48.04	5.40	882		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A

PROJECT:	T201609002 I-95 and SR 896 Interchange		
DRAINAGE SUBAREA ID:	BMP No. 2XX		
COUNTY:	New Castle	UNIT HYDROGRAPH:	STD
TMDL Watershed:	Christina River	LANDUSE:	#REF!

DURMM OUTPUT WORKSHEET

DURMM v2.51.190603

Site Data

Contributing Area to BMPs (ac.)	4.10				
C.A. RCN	88.78				
Subarea LOD (ac.)	2.54				
Subarea RCN	84.96				
Upstream Subarea ID	N/A	N/A	N/A	N/A	
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	2.54				
Combined RCN with Upstream Areas (ac.)	84.96				
Watershed TMDL-TN (lb/ac/yr)	5.70				
Watershed TMDL-TP (lb/ac/yr)	0.35				
Watershed TMDL-TSS (lb/ac/yr)	N/A				

BMP Data

BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
13-B Wet Extended Detention (ED) Pond	--	--	--	--
RPv runoff volume after all reductions (in.)	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	0.00	N/A	N/A	N/A
Total RPv runoff reduction (%)	0%	N/A	N/A	N/A
RPv Compliance Met Through Runoff Reduction?	NO	N/A	N/A	N/A
RPv Residual Volume (cu. ft.)	608	N/A	N/A	N/A
Adjusted pollutant load, TN (lb/ac/yr)	11.72	N/A	N/A	N/A
Adjusted pollutant load, TP (lb/ac/yr)	1.32	N/A	N/A	N/A
Adjusted pollutant load, TSS (lb/ac/yr)	215.20	N/A	N/A	N/A
Cv runoff volume after all reductions (in.)	3.56	N/A	N/A	N/A
Fv runoff volume after all reductions (in.)	6.66	N/A	N/A	N/A

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	1.78	
Annual Runoff for Contributing Area (in.)	26.37	
Req'd RPv to be Managed for Contributing Area (in.)	0.04	
Req'd RPv to be Managed for Contributing Area (%)	2%	
RPv Runoff Management Required (cu. Ft.)	608	
RPv Runoff Management Provided (cu. Ft.)	0	
RPv Residual Volume (cu.ft.)	608	SHORTFALL (Requires additional management or offset)
C.A. RPv avg. discharge rate (cfs)	0.00	
C.A. RPv max. discharge rate (cfs)	0.02	
TN Pollutant Load (lb/yr)	48.04	
TP Pollutant Load (lb/yr)	5.40	
TSS Pollutant Load (lb/yr)	882	

Conveyance Event (Cv)

Cv runoff volume (in.)	3.56
Adjusted RCN for H&H Modeling (CN*)	88.78

Flooding Event (Fv)

Fv runoff volume (in.)	6.66
Equivalent RCN for H&H Modeling (CN*)	88.78

Adjusted Subarea Data for Downstream DURMM Modeling

Subarea ID	BMP No. 2XX
Contributing Area (ac.)	4.10
Weighted Target Runoff (in.)	1.49
Adjusted CN after all reductions	88.78
Adjusted RPv (in.)	1.78
Adjusted Cv (in.)	3.56
Adjusted Fv (in.)	6.66

Adjusted Subarea Data for Nutrient Protocol Modeling

Contributing Area (ac.)	4.10
LOD Area (ac.)	2.54
TN Pollutant Load (lb/yr)	48.04
TP Pollutant Load (lb/yr)	5.40
TSS Pollutant Load (lb/yr)	882
Percent Impervious Cover	28%

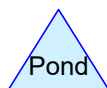
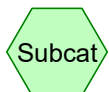
Adjusted Subarea Data for the Summary Table for Sub-Areas Draining to a Common Point of Interest

Subarea ID	BMP No. 2XX	
Contributing Area (ac.)	4.10	
RPv Residual Volume (cu.ft.)	608	SHORTFALL (Requires additional management or offset)
Adjusted CN after all reductions	88.78	
Cv RCN for H&H Modeling	88.78	
Fv RCN for H&H Modeling	88.78	
TN Pollutant Load (lb/yr)	48.04	
TP Pollutant Load (lb/yr)	5.40	
TSS Pollutant Load (lb/yr)	882	



DA to BMP No. 2XX

BMP No. 2XX



CONCEPT DESIGN

Drainage Diagram for I95&SR896 Preliminary SWM

Prepared by CEI, Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

I95&SR896 Preliminary SWM*Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05*

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 2

Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment2S: DA to BMP No. 2XXRunoff Area=4.100 ac 48.78% Impervious Runoff Depth=1.80"
Flow Length=294' Tc=6.0 min CN=89 Runoff=12.31 cfs 0.614 af**Pond 2P: BMP No. 2XX**Peak Elev=67.47' Storage=63,971 cf Inflow=12.31 cfs 0.614 af
Outflow=0.02 cfs 0.110 af**Total Runoff Area = 4.100 ac Runoff Volume = 0.614 af Average Runoff Depth = 1.80"**
51.22% Pervious = 2.100 ac 48.78% Impervious = 2.000 ac

I95&SR896 Preliminary SWM

Prepared by CEI

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05

Printed 2/10/2020

Page 3

Summary for Subcatchment 2S: DA to BMP No. 2XX

Runoff = 12.31 cfs @ 11.97 hrs, Volume= 0.614 af, Depth= 1.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

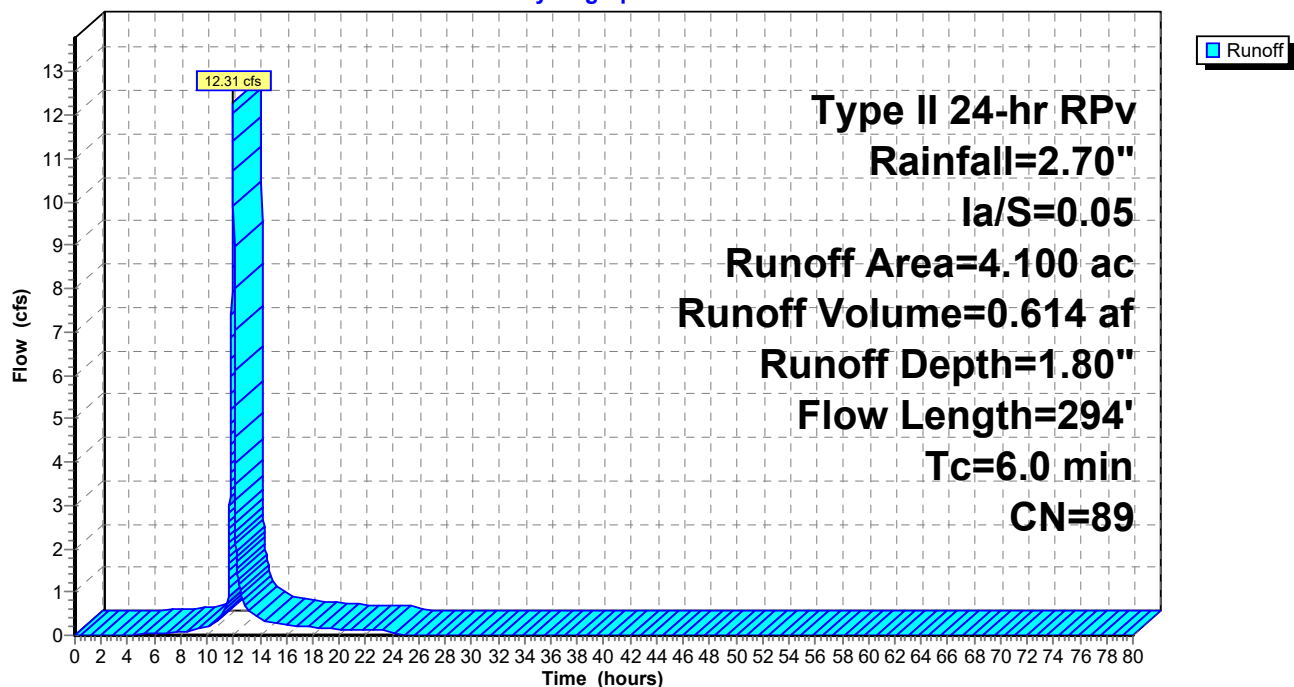
Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05

Area (ac)	CN	Description
2.100	80	>75% Grass cover, Good, HSG D
2.000	98	Paved roads w/curbs & sewers, HSG D
4.100	89	Weighted Average
2.100		51.22% Pervious Area
2.000		48.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	12	0.1660	0.18		Sheet Flow, Grass: Dense n= 0.240 P2= 3.30"
0.9	282	0.0745	5.32	8.65	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=0.50' Z= 6.0 & 7.0 ' Top.W=6.50' n= 0.030 Earth, grassed & winding
2.0	294	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: DA to BMP No. 2XX

Hydrograph



I95&SR896 Preliminary SWMType II 24-hr R_{Pv} Rainfall=2.70", I_a/S=0.05

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 4

Hydrograph for Subcatchment 2S: DA to BMP No. 2XX

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	52.00	2.70	1.80	0.00
1.00	0.03	0.00	0.00	53.00	2.70	1.80	0.00
2.00	0.06	0.00	0.00	54.00	2.70	1.80	0.00
3.00	0.09	0.00	0.01	55.00	2.70	1.80	0.00
4.00	0.13	0.00	0.01	56.00	2.70	1.80	0.00
5.00	0.17	0.01	0.03	57.00	2.70	1.80	0.00
6.00	0.22	0.02	0.04	58.00	2.70	1.80	0.00
7.00	0.27	0.03	0.06	59.00	2.70	1.80	0.00
8.00	0.32	0.05	0.08	60.00	2.70	1.80	0.00
9.00	0.40	0.07	0.13	61.00	2.70	1.80	0.00
10.00	0.49	0.11	0.19	62.00	2.70	1.80	0.00
11.00	0.63	0.18	0.40	63.00	2.70	1.80	0.00
12.00	1.79	1.01	11.40	64.00	2.70	1.80	0.00
13.00	2.08	1.26	0.63	65.00	2.70	1.80	0.00
14.00	2.21	1.37	0.38	66.00	2.70	1.80	0.00
15.00	2.30	1.45	0.30	67.00	2.70	1.80	0.00
16.00	2.38	1.51	0.23	68.00	2.70	1.80	0.00
17.00	2.43	1.56	0.20	69.00	2.70	1.80	0.00
18.00	2.49	1.61	0.18	70.00	2.70	1.80	0.00
19.00	2.53	1.65	0.16	71.00	2.70	1.80	0.00
20.00	2.57	1.68	0.13	72.00	2.70	1.80	0.00
21.00	2.60	1.71	0.13	73.00	2.70	1.80	0.00
22.00	2.64	1.74	0.12	74.00	2.70	1.80	0.00
23.00	2.67	1.77	0.12	75.00	2.70	1.80	0.00
24.00	2.70	1.80	0.11	76.00	2.70	1.80	0.00
25.00	2.70	1.80	0.00	77.00	2.70	1.80	0.00
26.00	2.70	1.80	0.00	78.00	2.70	1.80	0.00
27.00	2.70	1.80	0.00	79.00	2.70	1.80	0.00
28.00	2.70	1.80	0.00	80.00	2.70	1.80	0.00
29.00	2.70	1.80	0.00				
30.00	2.70	1.80	0.00				
31.00	2.70	1.80	0.00				
32.00	2.70	1.80	0.00				
33.00	2.70	1.80	0.00				
34.00	2.70	1.80	0.00				
35.00	2.70	1.80	0.00				
36.00	2.70	1.80	0.00				
37.00	2.70	1.80	0.00				
38.00	2.70	1.80	0.00				
39.00	2.70	1.80	0.00				
40.00	2.70	1.80	0.00				
41.00	2.70	1.80	0.00				
42.00	2.70	1.80	0.00				
43.00	2.70	1.80	0.00				
44.00	2.70	1.80	0.00				
45.00	2.70	1.80	0.00				
46.00	2.70	1.80	0.00				
47.00	2.70	1.80	0.00				
48.00	2.70	1.80	0.00				
49.00	2.70	1.80	0.00				
50.00	2.70	1.80	0.00				
51.00	2.70	1.80	0.00				

I95&SR896 Preliminary SWMType II 24-hr R_{Pv} Rainfall=2.70", I_a/S=0.05

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 5

Summary for Pond 2P: BMP No. 2XX

Inflow Area = 4.100 ac, 48.78% Impervious, Inflow Depth = 1.80" for R_{Pv} event
 Inflow = 12.31 cfs @ 11.97 hrs, Volume= 0.614 af
 Outflow = 0.02 cfs @ 24.12 hrs, Volume= 0.110 af, Atten= 100%, Lag= 729.2 min
 Primary = 0.02 cfs @ 24.12 hrs, Volume= 0.110 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Starting Elev= 66.00' Surf.Area= 16,127 sf Storage= 38,047 cf
 Peak Elev= 67.47' @ 24.12 hrs Surf.Area= 19,154 sf Storage= 63,971 cf (25,924 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= 1,946.3 min (2,741.7 - 795.4)

Volume	Invert	Avail.Storage	Storage Description
#1	62.00'	176,284 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
62.00	5,559	0	0
63.00	6,888	6,224	6,224
64.00	8,314	7,601	13,825
65.00	9,855	9,085	22,909
65.01	14,212	120	23,029
66.00	16,127	15,018	38,047
67.00	18,152	17,140	55,187
68.00	20,279	19,216	74,402
69.00	22,512	21,396	95,798
70.00	24,847	23,680	119,477
71.00	27,286	26,067	145,544
72.00	34,195	30,741	176,284

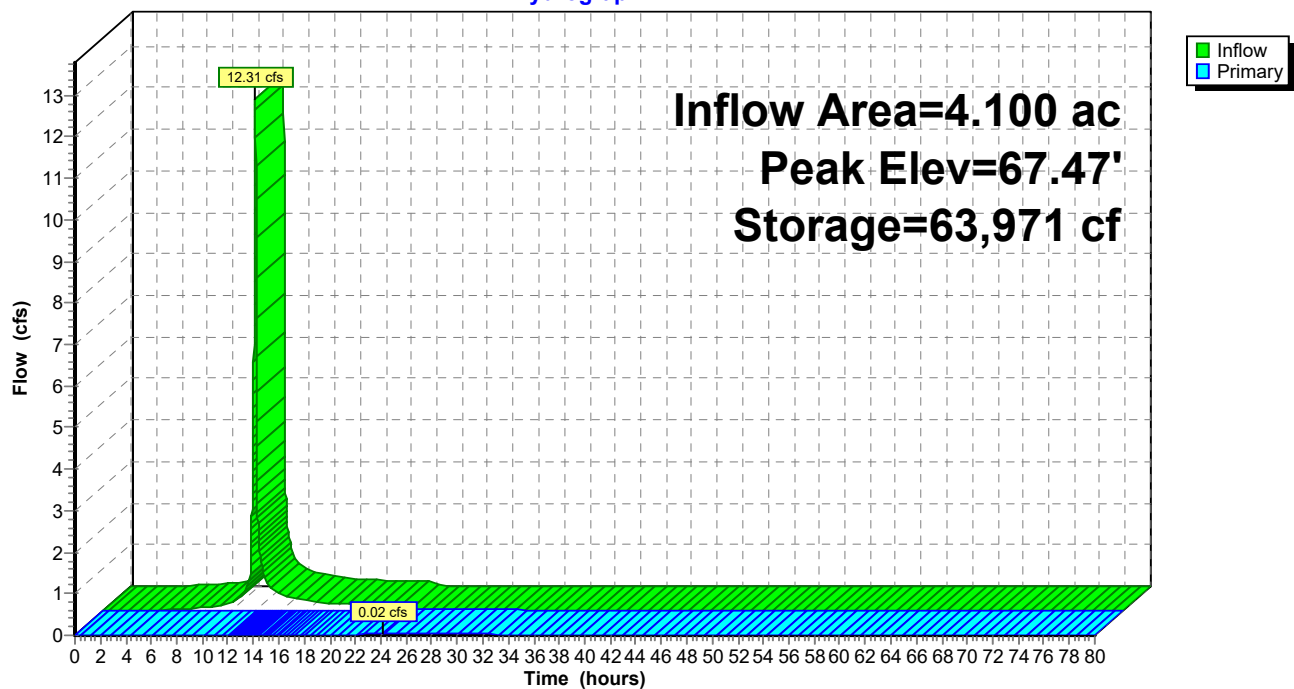
Device	Routing	Invert	Outlet Devices
#1	Primary	66.00'	24.0" Round Culvert L= 80.0' Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 65.50' S= 0.0063 '/ Cc= 0.900 n= 0.012 Concrete pipe, finished
#2	Device 1	66.75'	1.0" Vert. Orifice/Grate C= 0.600
#3	Device 1	68.00'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Head (feet) 0.00 2.00 Width (feet) 4.00 4.00
#4	Device 1	70.00'	48.0" x 30.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.02 cfs @ 24.12 hrs HW=67.47' (Free Discharge)

1=Culvert (Passes 0.02 cfs of 8.79 cfs potential flow)
 2=Orifice/Grate (Orifice Controls 0.02 cfs @ 3.97 fps)
 3=Custom Weir/Orifice (Controls 0.00 cfs)
 4=Orifice/Grate (Controls 0.00 cfs)

Pond 2P: BMP No. 2XX

Hydrograph



I95&SR896 Preliminary SWM

Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 7

Hydrograph for Pond 2P: BMP No. 2XX

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	38,047	66.00	0.00
2.00	0.00	38,047	66.00	0.00
4.00	0.01	38,095	66.00	0.00
6.00	0.04	38,288	66.01	0.00
8.00	0.08	38,704	66.04	0.00
10.00	0.19	39,614	66.10	0.00
12.00	11.40	50,258	66.72	0.00
14.00	0.38	58,177	67.16	0.02
16.00	0.23	60,205	67.27	0.02
18.00	0.18	61,540	67.34	0.02
20.00	0.13	62,519	67.39	0.02
22.00	0.12	63,271	67.43	0.02
24.00	0.11	63,949	67.47	0.02
26.00	0.00	63,830	67.46	0.02
28.00	0.00	63,676	67.46	0.02
30.00	0.00	63,523	67.45	0.02
32.00	0.00	63,370	67.44	0.02
34.00	0.00	63,218	67.43	0.02
36.00	0.00	63,068	67.42	0.02
38.00	0.00	62,918	67.42	0.02
40.00	0.00	62,769	67.41	0.02
42.00	0.00	62,621	67.40	0.02
44.00	0.00	62,474	67.39	0.02
46.00	0.00	62,328	67.38	0.02
48.00	0.00	62,183	67.38	0.02
50.00	0.00	62,039	67.37	0.02
52.00	0.00	61,896	67.36	0.02
54.00	0.00	61,754	67.35	0.02
56.00	0.00	61,612	67.35	0.02
58.00	0.00	61,472	67.34	0.02
60.00	0.00	61,333	67.33	0.02
62.00	0.00	61,194	67.32	0.02
64.00	0.00	61,057	67.32	0.02
66.00	0.00	60,920	67.31	0.02
68.00	0.00	60,785	67.30	0.02
70.00	0.00	60,650	67.30	0.02
72.00	0.00	60,516	67.29	0.02
74.00	0.00	60,384	67.28	0.02
76.00	0.00	60,252	67.27	0.02
78.00	0.00	60,121	67.27	0.02
80.00	0.00	59,991	67.26	0.02

Appendix G

BMP No. 3XX

PROJECT: T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID: BMP No. 3XX
LOCATION (County): New Castle
UNIT HYDROGRAPH: STD

CONTRIBUTING AREA RUNOFF CURVE NUMBER
(C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type							
			A		B		C		D	
			Acres	RCN	Acres	RCN	Acres	RCN	Acres	RCN
CULTIVATED AGRICULTURAL LANDS										
Fallow	Bare soil	----		77		86		91		94
	Crop residue (CR)	poor		76		85		90		93
	Crop residue (CR)	good		74		83		88		90
Row Crops	Straight row (SR)	poor		72		81		88		91
	Straight row (SR)	good		67		78		85		89
	SR + Crop residue	poor		71		80		87		90
	SR + Crop residue	good		64		75		82		85
	Contoured (C)	poor		70		79		84		88
	Contoured (C)	good		65		75		82		86
	C + Crop residue	poor		69		78		83		87
	C + Crop residue	good		64		74		81		85
	Cont & terraced(C&T)	poor		66		74		80		82
	Cont & terraced(C&T)	good		62		71		78		81
Small Grain	C&T + Crop residue	poor		65		73		79		81
	C&T + Crop residue	good		61		70		77		80
	Straight row (SR)	poor		65		76		84		88
	Straight row (SR)	good		63		75		83		87
	SR + Crop residue	poor		64		75		83		86
	SR + Crop residue	good		60		72		80		84
	Contoured (C)	poor		63		74		82		85
	Contoured (C)	good		61		73		81		84
	C + Crop residue	poor		62		73		81		84
	C + Crop residue	good		60		72		80		83
Close-seeded or broadcast legumes or rotation meadow	Cont & terraced(C&T)	poor		61		72		79		82
	Cont & terraced(C&T)	good		59		70		78		81
	C&T + Crop residue	poor		60		71		78		81
	C&T + Crop residue	good		58		69		77		80
	Straight row	poor		66		77		85		89
	Straight row	good		58		72		81		85
	Contoured	poor		64		75		83		85
	Contoured	good		55		69		78		83
	Cont & terraced	poor		63		73		80		83
	Cont & terraced	good		51		67		76		80
OTHER AGRICULTURAL LANDS										
Pasture, grassland or range	poor		68		79		86		89	
	fair		49		69		79		84	
	good		39		61		74		80	
Meadow -cont. grass (non grazed)	----		30		58		71		78	
	poor		48		67		77		83	
	fair		35		56		70		77	
Brush - brush, weed, grass mix	good		30		48		65		73	
	poor		57		73		82		86	
	fair		43		65		76		82	
Woods - grass combination	good		32		58		72		79	
	poor		45		66		77		83	
	fair		36		60		73		79	
Woods	poor		30		55		70		77	
	fair		36		60		73		79	
	good		30		55		70		77	
Farmsteads	----		59		74		82		86	
FULLY DEVELOPED URBAN AREAS (Veg Established)										
Open space (Lawns, parks etc.)	Poor condition; grass cover < 50%		68		79		86		89	
	Fair condition; grass cover 50% to 75 %		49		69		79		84	
	Good condition; grass cover > 75%		39		61		74	3.34	80	
Impervious Areas	Paved parking lots, roofs, driveways		98		98		98	2.92	98	
	Streets and roads									
	Paved; curbs and storm sewers		98		98		98		98	
	Paved; open ditches (w/right-of-way)		83		89		92		93	
	Gravel (w/ right-of-way)		76		85		89		91	
	Dirt (w/ right-of-way)		72		82		87		89	
Urban Districts	Avg % impervious									
	Commercial & business	85		89		92		94		95
Industrial	72		81		88		91		93	
Residential districts by average lot size	Avg % impervious									
	1/8 acre (town houses)	65		77		85		90		92
	1/4 acre	38		61		75		83		87
	1/3 acre	30		57		72		81		86
	1/2 acre	25		54		70		80		85
	1 acre	20		51		68		79		84
	2 acre	12		46		65		77		82
DEVELOPING URBAN AREA (No Vegetation)										
Newly graded area (pervious only)			77		86		91		94	
USER DEFINED										
Subarea Contributing Area per Soil Type (ac)			0	0	0	6.26				
Subarea Contributing Area (ac)			6.26							
Subarea Weighted RCN			88							
UPSTREAM CONTRIBUTING AREAS										
Subarea ID	Acres	RCN								
Upstream Contributing Area 1										
Upstream Contributing Area 2										
Upstream Contributing Area 3										
Upstream Contributing Area 4										
Total Contributing Area w. Upstream Areas (ac)			6.26							
Weighted Runoff Curve Number (RCN)			88							

PROJECT:	T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID:	BMP No. 3XX
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	STD

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data

- 1.1 HSG Area Within LOD (ac)
- 1.2 Pre-Developed Woods/Meadow Within LOD (ac)
- 1.3 Pre-Developed Impervious Within LOD (ac)
- 1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); OR
- 1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)

HSG A	HSG B	HSG C	HSG D
			5.11
			0
			0.68
			1.82
0%	0%	0%	36%

Step 2 - Subarea LOD Runoff Calculations

- 2.1 RCN per HSG
- 2.2 RPv per HSG (in.)
- 2.3 Target RCN per HSG
- 2.4 Target Runoff per HSG (in.)

0.00	0.00	0.00	86.41
0.00	0.00	0.00	1.64
0.00	0.00	0.00	82.04
0.00	0.00	0.00	1.40

- 2.5 Subarea LOD (ac)
- 2.6 Subarea Weighted RCN
- 2.7 Subarea Weighted RPv (in.)
- 2.8 Subarea Weighted Target Runoff (in.)

5.11
86.41
1.64
1.40

Step 3 - Upstream LOD Areas (from previous DURMM Report as applicable)

- 3.1 Upstream Sub-Area ID
- 3.2 Upstream Contributing Area (ac)
- 3.3 Target Runoff for Upstream Area (in.)
- 3.4 Adjusted CN after all reductions
- 3.5 Adjusted RPv (in.)
- 3.6 Adjusted Cv (in.)
- 3.7 Adjusted Fv (in.)

Area 1	Area 2	Area 3	Area 4

Step 4 - RPv Calculations for Combined LOD

- 4.1 Combined LOD (ac)
- 4.2 Weighted RCN
- 4.3 Weighted RPv (in.)
- 4.4 Weighted Target Runoff (in.)
- 4.5 Estimated Annual Runoff (in.)
- 4.6 Req'd Runoff to be Managed within LOD (in.)
- 4.7 Req'd Runoff to be Managed within LOD (%)

5.11
86.41
1.64
1.40
23.99
0.23
14%

PROJECT:	T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID:	BMP No. 3XX
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	STD

**OUTSIDE LIMIT OF DISTURBANCE
(OLOD) WORKSHEET**

Step 1 - Site Data

1.1 Total Contributing Area (ac)	6.26
1.2 C.A. RCN	88
1.3 LOD Area (ac)	5.11
1.4 LOD RCN	86
1.5 Outside LOD Area (ac)	1.15
1.6 Outside LOD RCN	97

Step 2 - Time of Concentration

	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
FLOW TYPE						
<i>Sheet</i>				-----	N/A	0.00
				-----	N/A	0.00
				-----	N/A	0.00
<i>Shallow Concentrated</i>				N/A	-----	0.00
				N/A	-----	0.00
				N/A	-----	0.00
<i>Open Channel</i>			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
2.7 Time of Concentration (Tc)						0.10

Sheet Flow Surface Codes

a smooth surface	f grass, dense
b fallow (no residue)	g grass, bermuda
c cultivated < 20% Res.	h woods, light
d cultivated > 20% Res.	i woods, dense
e grass - range, short	j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

3.1 Unit Hydrograph Type	STD	
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	0.062	0.062
3.5 Ia/P ratio	0.01	0.01
3.6 Unit Peak Discharge, qu (csm/in)	831	816
3.7 Runoff (in.)	4.47	7.67
3.8 Peak Discharge, qp (cfs)	6.68	11.24
3.9 Equiv. unit peak discharge (cfs/ac)	5.81	9.77

PROJECT: T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID: BMP No. 3XX
LOCATION (County): New Castle

RESOURCE PROTECTION EVENT (RPv) WORKSHEET

Step 1 - Calculate Initial RPv

- 1.1 Total contributing area to BMP (ac)
- 1.2 Initial RCN
- 1.3 RPv for Contributing Area (in.)
- 1.4 Req'd RPv to be Managed for Contributing Area (in.)
- 1.5 Req'd RPv to be Managed for Contributing Area (%)

BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
Type	13-B Wet Extended Detention (ED) Pond	Type	--	Type	--	Type	--	Type	--
Data									
6.26									
88.40									
1.76									
0.19									
11%									

Step 2 - Adjust for Retention Reduction

- 2.1 Retention volume provided (cu. ft.)
- 2.2 Retention reduction allowance (%)
- 2.3 Retention reduction volume (ac-ft)
- 2.4 Retention reduction volume (in.)
- 2.5 Runoff volume after retention reduction (in.)
- 2.6 Adjusted CN*

0%		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
1.76		N/A		N/A		N/A		N/A	
88.40		N/A		N/A		N/A		N/A	

Step 3 - Adjust for Annual Runoff Reduction

- 3.1 Annual CN (ACN)
- 3.2 Annual runoff (in.)
- 3.3 Proportion A/B soils in BMP footprint (%)
- 3.4 Annual runoff reduction allowance (%)
- 3.5 Annual runoff after reduction (in.)
- 3.6 Adjusted ACN
- 3.7 Annual Runoff Reduction Allowance for RPv (in.)

88.40		N/A		N/A		N/A		N/A	
25.98		N/A		N/A		N/A		N/A	
0%		0%		0%		0%		0%	
0%		N/A		N/A		N/A		N/A	
25.98		N/A		N/A		N/A		N/A	
88.40		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	

Step 4 - Calculate RPv with BMP Reductions

- 4.1 RPv Runoff Manangement Provided (cu. ft.)
- 4.2 RPv runoff volume after all reductions (in.)
- 4.3 RPv runoff volume after all reductions (cu.ft.)
- 4.4 Total RPv runoff reduction (in.)
- 4.5 Total RPv runoff reduction (%)
- 4.6 Adjusted CN after all reductions*
- 4.7 Adjusted equivalent annual runoff (in.)
- 4.8 RPv Compliance Met Through Runoff Reduction?
- 4.9 Runoff Reduction Credit, if Applicable (cu.ft)

0		N/A		N/A		N/A		N/A	
1.76		N/A		N/A		N/A		N/A	
39,954		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
0%		N/A		N/A		N/A		N/A	
88.40		N/A		N/A		N/A		N/A	
25.98		N/A		N/A		N/A		N/A	
NO		N/A		N/A		N/A		N/A	
N/A		N/A		N/A		N/A		N/A	

Step 5 - Determine Residual Volume to be Managed or Offset

- 5.1 RPv Residual Volume (in.)
- 5.2 RPv Residual Volume (cu.ft./ac)
- 5.3 Residual Volume to be Managed or Offset (cu.ft.)
- 5.4 RPv avg. discharge rate for 48-hr detention (cfs)
- 5.5 RPv max. discharge rate for 48-hr detention (cfs)

0.19		N/A		N/A		N/A		N/A	
695		N/A		N/A		N/A		N/A	
4,352		N/A		N/A		N/A		N/A	
0.025		N/A		N/A		N/A		N/A	
0.126		N/A		N/A		N/A		N/A	

*NOTE: No additional runoff reduction credit can be taken for surface recharge practices once the "Adjusted CN after all reductions" (Step 4.6) reaches the equivalent CN for the native soil-cover condition of the BMP footprint itself (i.e. for Sheet Flow to Turf Filter Strip on B soils Step 4.6 cannot be below 61). If this occurs contact the DNREC – SSP for further guidance

PROJECT:	T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID:	BMP No. 3XX
TMDL WATERSHED:	Christina River

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

Step 1 - Calculate Annual Runoff Volume

- 1.1 Total contributing area to BMP (ac)
- 1.2 Initial RCN
- 1.3 Annual runoff volume (in.)
- 1.4 Annual runoff volume (liters)

BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
Type:	13-B Wet Extended Detention (ED) Pond			Type:	--			Type:	--			Type:	--			Type:	--		
Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
6.26																			
88																			
25.98																			
1.67E+07																			

Step 2 - Calculate Annual Pollutant Load

- 2.1 EMC (mg/L)
- 2.2 Load (mg/yr)
- 2.3 Stormwater Load (lb/ ac/yr)

	2.80	0.49	90		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	4.68E+07	8.19E+06	1.50E+09		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	16.49	2.88	529.88		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A

Step 3 - Adjust for Pollutant Reduction

- 3.1 BMP annual runoff reduction (%)
- 3.2 Adjusted annual runoff volume (in)
- 3.3 Adjusted annual runoff volume (liters)
- 3.4 Adjusted load from annual reductions (lb/ac/yr)
- 3.5 BMP removal efficiency (%)
- 3.6 BMP effluent concentration (mg/L)
- 3.7 Final Adjusted load (lb/ ac/yr)

0%				N/A				N/A				N/A				N/A			
25.98				N/A				N/A				N/A				N/A			
1.67E+07				N/A				N/A				N/A				N/A			
	16.49	2.88	529.88		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	30%	55%	60%		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	1.96	0.22	36.00		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	11.54	1.30	211.95		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A

Step 4 - Pollutant Reduction Met? (For Informational Purposes)

- 4.1 TMDL (lb/ac/yr)
- 4.2 Reduction met?
- 4.3 Final Adjusted Load (lb/yr)

	5.70	0.35	N/A																
	NO	NO	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	72.24	8.13	1327		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A

PROJECT:	T201609002 I-95 and SR 896 Interchange		
DRAINAGE SUBAREA ID:	BMP No. 3XX		
COUNTY:	New Castle	UNIT HYDROGRAPH:	STD
TMDL Watershed:	Christina River	LANDUSE:	#REF!

DURMM OUTPUT WORKSHEET

DURMM v2.51.190603

Site Data

Contributing Area to BMPs (ac.)	6.26				
C.A. RCN	88.40				
Subarea LOD (ac.)	5.11				
Subarea RCN	86.41				
Upstream Subarea ID	N/A	N/A	N/A	N/A	
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	5.11				
Combined RCN with Upstream Areas (ac.)	86.41				
Watershed TMDL-TN (lb/ac/yr)	5.70				
Watershed TMDL-TP (lb/ac/yr)	0.35				
Watershed TMDL-TSS (lb/ac/yr)	N/A				

BMP Data

BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
13-B Wet Extended Detention (ED) Pond	--	--	--	--
RPv runoff volume after all reductions (in.)	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	0.00	N/A	N/A	N/A
Total RPv runoff reduction (%)	0%	N/A	N/A	N/A
RPv Compliance Met Through Runoff Reduction?	NO	N/A	N/A	N/A
RPv Residual Volume (cu. ft.)	4,352	N/A	N/A	N/A
Adjusted pollutant load, TN (lb/ac/yr)	11.54	N/A	N/A	N/A
Adjusted pollutant load, TP (lb/ac/yr)	1.30	N/A	N/A	N/A
Adjusted pollutant load, TSS (lb/ac/yr)	211.95	N/A	N/A	N/A
Cv runoff volume after all reductions (in.)	3.52	N/A	N/A	N/A
Fv runoff volume after all reductions (in.)	6.62	N/A	N/A	N/A

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	1.76	
Annual Runoff for Contributing Area (in.)	25.98	
Req'd RPv to be Managed for Contributing Area (in.)	0.19	
Req'd RPv to be Managed for Contributing Area (%)	11%	
RPv Runoff Management Required (cu. Ft.)	4352	
RPv Runoff Management Provided (cu. Ft.)	0	
RPv Residual Volume (cu.ft.)	4352	SHORTFALL (Requires additional management or offset)
C.A. RPv avg. discharge rate (cfs)	0.03	
C.A. RPv max. discharge rate (cfs)	0.13	
TN Pollutant Load (lb/yr)	72.24	
TP Pollutant Load (lb/yr)	8.13	
TSS Pollutant Load (lb/yr)	1327	

Conveyance Event (Cv)

Cv runoff volume (in.)	3.52
Adjusted RCN for H&H Modeling (CN*)	88.40

Flooding Event (Fv)

Fv runoff volume (in.)	6.62
Equivalent RCN for H&H Modeling (CN*)	88.40

Adjusted Subarea Data for Downstream DURMM Modeling

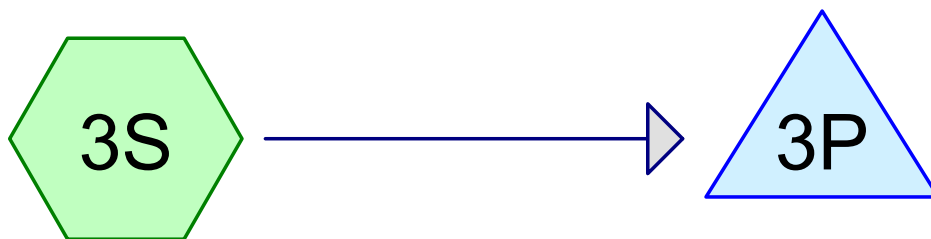
Subarea ID	BMP No. 3XX
Contributing Area (ac.)	6.26
Weighted Target Runoff (in.)	1.40
Adjusted CN after all reductions	88.40
Adjusted RPv (in.)	1.76
Adjusted Cv (in.)	3.52
Adjusted Fv (in.)	6.62

Adjusted Subarea Data for Nutrient Protocol Modeling

Contributing Area (ac.)	6.26
LOD Area (ac.)	5.11
TN Pollutant Load (lb/yr)	72.24
TP Pollutant Load (lb/yr)	8.13
TSS Pollutant Load (lb/yr)	1327
Percent Impervious Cover	36%

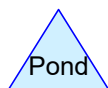
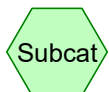
Adjusted Subarea Data for the Summary Table for Sub-Areas Draining to a Common Point of Interest

Subarea ID	BMP No. 3XX	
Contributing Area (ac.)	6.26	
RPv Residual Volume (cu.ft.)	4352	SHORTFALL (Requires additional management or offset)
Adjusted CN after all reductions	88.40	
Cv RCN for H&H Modeling	88.40	
Fv RCN for H&H Modeling	88.40	
TN Pollutant Load (lb/yr)	72.24	
TP Pollutant Load (lb/yr)	8.13	
TSS Pollutant Load (lb/yr)	1327	



DA to BMP No. 3XX

BMP No. 3XX



CONCEPT DESIGN

Drainage Diagram for I95&SR896 Preliminary SWM

Prepared by CEI, Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

I95&SR896 Preliminary SWM*Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05*

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 2

Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment3S: DA to BMP No. 3XXRunoff Area=6.260 ac 46.65% Impervious Runoff Depth=1.73"
Flow Length=309' Tc=6.0 min CN=88 Runoff=18.19 cfs 0.904 af**Pond 3P: BMP No. 3XX**Peak Elev=62.98' Storage=116,175 cf Inflow=18.19 cfs 0.904 af
Outflow=0.11 cfs 0.528 af**Total Runoff Area = 6.260 ac Runoff Volume = 0.904 af Average Runoff Depth = 1.73"**
53.35% Pervious = 3.340 ac 46.65% Impervious = 2.920 ac

I95&SR896 Preliminary SWM

Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 3

Summary for Subcatchment 3S: DA to BMP No. 3XX

Runoff = 18.19 cfs @ 11.97 hrs, Volume= 0.904 af, Depth= 1.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

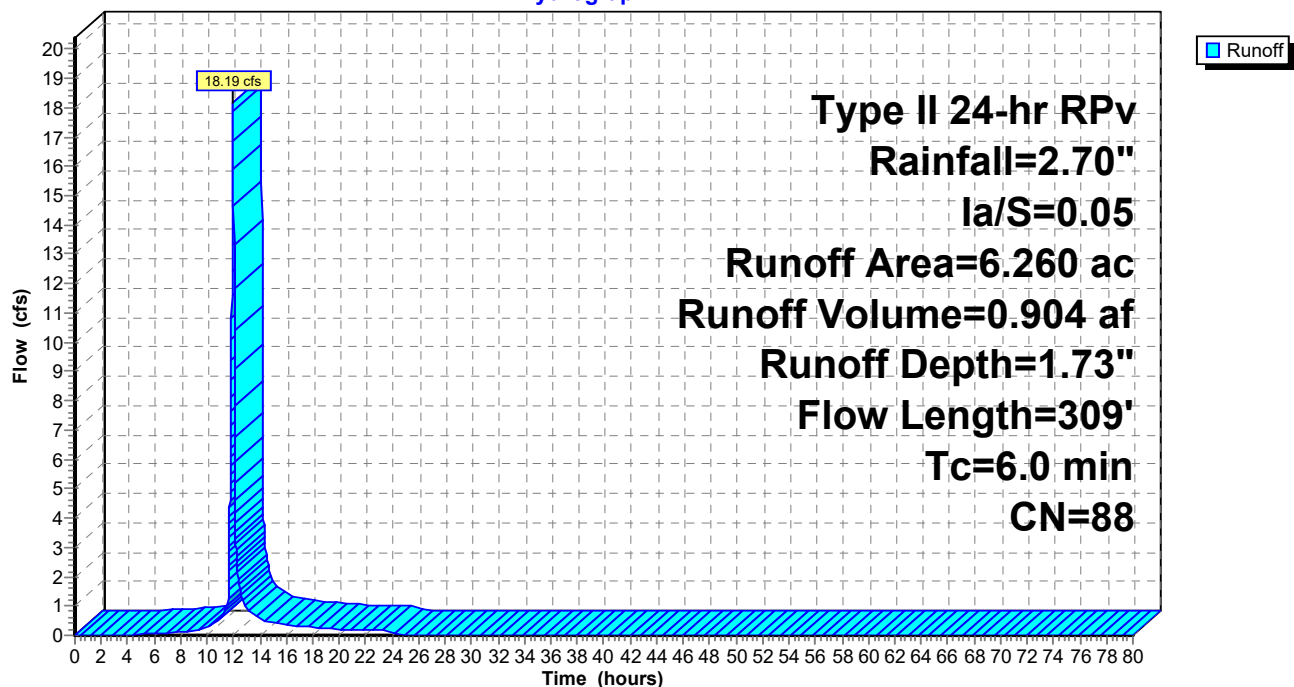
Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05

Area (ac)	CN	Description
3.340	80	>75% Grass cover, Good, HSG D
2.920	98	Paved roads w/curbs & sewers, HSG D
6.260	88	Weighted Average
3.340		53.35% Pervious Area
2.920		46.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	30	0.2500	0.26		Sheet Flow, Sheet Flow Grass: Dense n= 0.240 P2= 3.30"
0.4	68	0.0146	3.03	6.05	Trap/Vee/Rect Channel Flow, Bot.W=3.00' D=0.50' Z= 4.0 & 0.0 '/' Top.W=5.00' n= 0.030 Earth, grassed & winding
0.2	79	0.0157	7.15	8.77	Pipe Channel, 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
0.7	132	0.0246	3.08	12.32	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=0.50' Z= 14.0 & 18.0 '/' Top.W=16.00' n= 0.030 Earth, grassed & winding
3.3	309	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3S: DA to BMP No. 3XX

Hydrograph



I95&SR896 Preliminary SWM

Prepared by CEI

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Type II 24-hr R_{Pv} Rainfall=2.70", I_a/S=0.05

Printed 2/10/2020

Page 5

Hydrograph for Subcatchment 3S: DA to BMP No. 3XX

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	52.00	2.70	1.73	0.00
1.00	0.03	0.00	0.00	53.00	2.70	1.73	0.00
2.00	0.06	0.00	0.00	54.00	2.70	1.73	0.00
3.00	0.09	0.00	0.01	55.00	2.70	1.73	0.00
4.00	0.13	0.00	0.02	56.00	2.70	1.73	0.00
5.00	0.17	0.01	0.03	57.00	2.70	1.73	0.00
6.00	0.22	0.01	0.06	58.00	2.70	1.73	0.00
7.00	0.27	0.03	0.08	59.00	2.70	1.73	0.00
8.00	0.32	0.04	0.11	60.00	2.70	1.73	0.00
9.00	0.40	0.06	0.18	61.00	2.70	1.73	0.00
10.00	0.49	0.10	0.27	62.00	2.70	1.73	0.00
11.00	0.63	0.17	0.57	63.00	2.70	1.73	0.00
12.00	1.79	0.96	16.88	64.00	2.70	1.73	0.00
13.00	2.08	1.20	0.94	65.00	2.70	1.73	0.00
14.00	2.21	1.31	0.56	66.00	2.70	1.73	0.00
15.00	2.30	1.39	0.45	67.00	2.70	1.73	0.00
16.00	2.38	1.45	0.35	68.00	2.70	1.73	0.00
17.00	2.43	1.50	0.31	69.00	2.70	1.73	0.00
18.00	2.49	1.55	0.27	70.00	2.70	1.73	0.00
19.00	2.53	1.59	0.23	71.00	2.70	1.73	0.00
20.00	2.57	1.62	0.20	72.00	2.70	1.73	0.00
21.00	2.60	1.65	0.19	73.00	2.70	1.73	0.00
22.00	2.64	1.68	0.18	74.00	2.70	1.73	0.00
23.00	2.67	1.71	0.17	75.00	2.70	1.73	0.00
24.00	2.70	1.73	0.17	76.00	2.70	1.73	0.00
25.00	2.70	1.73	0.00	77.00	2.70	1.73	0.00
26.00	2.70	1.73	0.00	78.00	2.70	1.73	0.00
27.00	2.70	1.73	0.00	79.00	2.70	1.73	0.00
28.00	2.70	1.73	0.00	80.00	2.70	1.73	0.00
29.00	2.70	1.73	0.00				
30.00	2.70	1.73	0.00				
31.00	2.70	1.73	0.00				
32.00	2.70	1.73	0.00				
33.00	2.70	1.73	0.00				
34.00	2.70	1.73	0.00				
35.00	2.70	1.73	0.00				
36.00	2.70	1.73	0.00				
37.00	2.70	1.73	0.00				
38.00	2.70	1.73	0.00				
39.00	2.70	1.73	0.00				
40.00	2.70	1.73	0.00				
41.00	2.70	1.73	0.00				
42.00	2.70	1.73	0.00				
43.00	2.70	1.73	0.00				
44.00	2.70	1.73	0.00				
45.00	2.70	1.73	0.00				
46.00	2.70	1.73	0.00				
47.00	2.70	1.73	0.00				
48.00	2.70	1.73	0.00				
49.00	2.70	1.73	0.00				
50.00	2.70	1.73	0.00				
51.00	2.70	1.73	0.00				

I95&SR896 Preliminary SWMType II 24-hr R_{Pv} Rainfall=2.70", I_a/S=0.05

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 6

Summary for Pond 3P: BMP No. 3XX

Inflow Area = 6.260 ac, 46.65% Impervious, Inflow Depth = 1.73" for R_{Pv} event
 Inflow = 18.19 cfs @ 11.97 hrs, Volume= 0.904 af
 Outflow = 0.11 cfs @ 24.07 hrs, Volume= 0.528 af, Atten= 99%, Lag= 726.0 min
 Primary = 0.11 cfs @ 24.07 hrs, Volume= 0.528 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Starting Elev= 62.00' Surf.Area= 33,663 sf Storage= 81,537 cf
 Peak Elev= 62.98' @ 24.07 hrs Surf.Area= 37,355 sf Storage= 116,175 cf (34,639 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= 1,810.3 min (2,608.7 - 798.4)

Volume	Invert	Avail.Storage	Storage Description
#1	58.00'	361,058 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
58.00	11,909	0	0
59.00	14,948	13,429	13,429
60.00	18,124	16,536	29,965
61.00	21,401	19,763	49,727
61.01	30,079	257	49,984
62.00	33,663	31,552	81,537
63.00	37,448	35,556	117,092
64.00	41,352	39,400	156,492
65.00	45,374	43,363	199,855
66.00	49,516	47,445	247,300
67.00	53,776	51,646	298,946
68.00	70,447	62,112	361,058

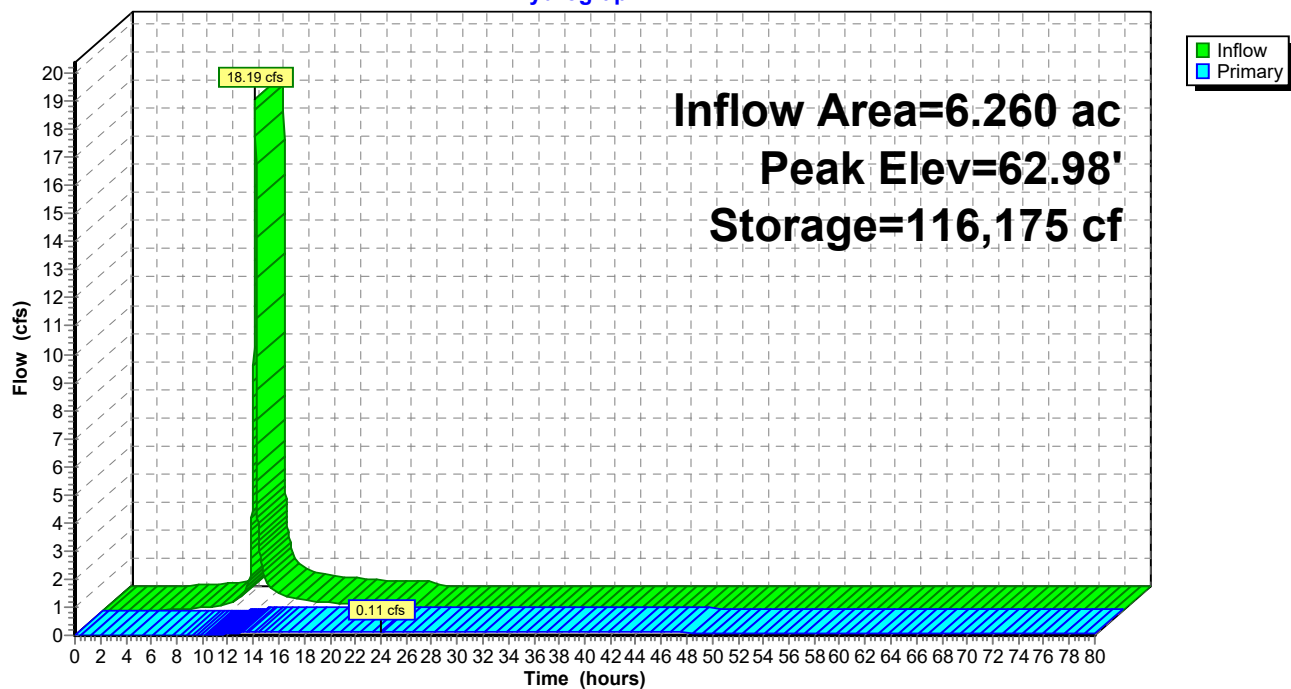
Device	Routing	Invert	Outlet Devices
#1	Primary	62.00'	24.0" Round Culvert L= 150.0' Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 61.04' S= 0.0064 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished
#2	Device 1	62.00'	2.1" Vert. Orifice/Grate C= 0.600
#3	Device 1	63.00'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Head (feet) 0.00 1.00 Width (feet) 3.50 3.50
#4	Device 1	64.00'	48.0" x 30.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.11 cfs @ 24.07 hrs HW=62.98' (Free Discharge)

1=Culvert (Passes 0.11 cfs of 4.80 cfs potential flow)
 2=Orifice/Grate (Orifice Controls 0.11 cfs @ 4.54 fps)
 3=Custom Weir/Orifice (Controls 0.00 cfs)
 4=Orifice/Grate (Controls 0.00 cfs)

Pond 3P: BMP No. 3XX

Hydrograph



I95&SR896 Preliminary SWM

Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 8

Hydrograph for Pond 3P: BMP No. 3XX

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	81,537	62.00	0.00
2.00	0.00	81,537	62.00	0.00
4.00	0.02	81,590	62.00	0.00
6.00	0.06	81,841	62.01	0.00
8.00	0.11	82,396	62.03	0.00
10.00	0.27	83,629	62.06	0.01
12.00	16.88	99,016	62.50	0.07
14.00	0.56	110,270	62.82	0.10
16.00	0.35	112,760	62.88	0.10
18.00	0.27	114,210	62.92	0.11
20.00	0.20	115,127	62.95	0.11
22.00	0.18	115,702	62.96	0.11
24.00	0.17	116,168	62.98	0.11
26.00	0.00	115,442	62.96	0.11
28.00	0.00	114,670	62.93	0.11
30.00	0.00	113,908	62.91	0.11
32.00	0.00	113,154	62.89	0.10
34.00	0.00	112,410	62.87	0.10
36.00	0.00	111,675	62.85	0.10
38.00	0.00	110,950	62.83	0.10
40.00	0.00	110,235	62.82	0.10
42.00	0.00	109,528	62.80	0.10
44.00	0.00	108,831	62.78	0.10
46.00	0.00	108,144	62.76	0.09
48.00	0.00	107,467	62.74	0.09
50.00	0.00	106,799	62.72	0.09
52.00	0.00	106,140	62.70	0.09
54.00	0.00	105,491	62.69	0.09
56.00	0.00	104,851	62.67	0.09
58.00	0.00	104,222	62.65	0.09
60.00	0.00	103,602	62.63	0.09
62.00	0.00	102,991	62.62	0.08
64.00	0.00	102,390	62.60	0.08
66.00	0.00	101,799	62.58	0.08
68.00	0.00	101,217	62.57	0.08
70.00	0.00	100,646	62.55	0.08
72.00	0.00	100,084	62.53	0.08
74.00	0.00	99,532	62.52	0.08
76.00	0.00	98,989	62.50	0.07
78.00	0.00	98,456	62.49	0.07
80.00	0.00	97,933	62.47	0.07

Appendix H

BMP No. 4XX

PROJECT: T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID: BMP No. 4XX
LOCATION (County): New Castle
UNIT HYDROGRAPH: STD

CONTRIBUTING AREA RUNOFF CURVE NUMBER
(C.A. RCN) WORKSHEET

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type								
			A		B		C		D		
			Acres	RCN	Acres	RCN	Acres	RCN	Acres	RCN	
CULTIVATED AGRICULTURAL LANDS											
Fallow	Bare soil	----		77		86		91		94	
	Crop residue (CR)	poor		76		85		90		93	
	Crop residue (CR)	good		74		83		88		90	
Row Crops	Straight row (SR)	poor		72		81		88		91	
	Straight row (SR)	good		67		78		85		89	
	SR + Crop residue	poor		71		80		87		90	
	SR + Crop residue	good		64		75		82		85	
	Contoured (C)	poor		70		79		84		88	
	Contoured (C)	good		65		75		82		86	
	C + Crop residue	poor		69		78		83		87	
	C + Crop residue	good		64		74		81		85	
	Cont & terraced(C&T)	poor		66		74		80		82	
	Cont & terraced(C&T)	good		62		71		78		81	
Small Grain	C&T + Crop residue	poor		65		73		79		81	
	C&T + Crop residue	good		61		70		77		80	
	Straight row (SR)	poor		65		76		84		88	
	Straight row (SR)	good		63		75		83		87	
	SR + Crop residue	poor		64		75		83		86	
	SR + Crop residue	good		60		72		80		84	
	Contoured (C)	poor		63		74		82		85	
	Contoured (C)	good		61		73		81		84	
	C + Crop residue	poor		62		73		81		84	
	C + Crop residue	good		60		72		80		83	
Close-seeded or broadcast legumes or rotation meadow	Cont & terraced(C&T)	poor		61		72		79		82	
	Cont & terraced(C&T)	good		59		70		78		81	
	C&T + Crop residue	poor		60		71		78		81	
	C&T + Crop residue	good		58		69		77		80	
	Straight row	poor		66		77		85		89	
	Straight row	good		58		72		81		85	
	Contoured	poor		64		75		83		85	
	Contoured	good		55		69		78		83	
	Cont & terraced	poor		63		73		80		83	
	Cont & terraced	good		51		67		76		80	
OTHER AGRICULTURAL LANDS											
Pasture, grassland or range	poor		68		79		86		89		
	fair		49		69		79		84		
	good		39		61		74		80		
Meadow -cont. grass (non grazed)	----		30		58		71		78		
	poor		48		67		77		83		
	fair		35		56		70		77		
Brush - brush, weed, grass mix	good		30		48		65		73		
	poor		57		73		82		86		
	fair		43		65		76		82		
Woods - grass combination	good		32		58		72		79		
	poor		45		66		77		83		
	fair		36		60		73		79		
Woods	good		30	7.52	55		70	2.99	77		
	poor		59		74		82		86		
	fair		59		74		82		86		
FULLY DEVELOPED URBAN AREAS (Veg Established)											
Open space (Lawns,parks etc.)	Poor condition; grass cover < 50%		68		79		86		89		
	Fair condition; grass cover 50% to 75 %		49		69		79		84		
	Good condition; grass cover > 75%		39	3.32	61		74	14.22	80		
Impervious Areas	Paved parking lots, roofs, driveways		98	3.56	98		98	7.39	98		
	Streets and roads										
	Paved; curbs and storm sewers		98		98		98		98		
	Paved; open ditches (w/right-of-way)		83		89		92		93		
	Gravel (w/ right-of-way)		76		85		89		91		
	Dirt (w/ right-of-way)		72		82		87		89		
Urban Districts	Avg % impervious										
	Commercial & business	85		89		92		94		95	
Residential districts by average lot size	Industrial	72		81		88		91		93	
	Avg % impervious										
	1/8 acre (town houses)	65		77		85		90		92	
	1/4 acre	38		61		75		83		87	
	1/3 acre	30		57		72		81		86	
	1/2 acre	25		54		70		80		85	
	1 acre	20		51		68		79		84	
	2 acre	12		46		65		77		82	
	DEVELOPING URBAN AREA (No Vegetation)										
	Newly graded area (pervious only)			77		86		91		94	
USER DEFINED											
Subarea Contributing Area per Soil Type (ac)			0	14.4	0	24.6					
Subarea Contributing Area (ac)			39								
Subarea Weighted RCN			78								
UPSTREAM CONTRIBUTING AREAS											
Subarea ID	Acres	RCN									
Upstream Contributing Area 1											
Upstream Contributing Area 2											
Upstream Contributing Area 3											
Upstream Contributing Area 4											
Total Contributing Area w. Upstream Areas (ac)			39								
Weighted Runoff Curve Number (RCN)			78								

PROJECT:	T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID:	BMP No. 4XX
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	STD

LIMIT OF DISTURBANCE (LOD) WORKSHEET

Step 1 - Subarea LOD Data

- 1.1 HSG Area Within LOD (ac)
- 1.2 Pre-Developed Woods/Meadow Within LOD (ac)
- 1.3 Pre-Developed Impervious Within LOD (ac)
- 1.4.a Post-Developed Imperviousness Within LOD, Option #1 (ac); OR
- 1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)

HSG A	HSG B	HSG C	HSG D
	4.92		19.37
	0		0
	0.63		4.43
	1.99		3.75
0%	40%	0%	19%

Step 2 - Subarea LOD Runoff Calculations

- 2.1 RCN per HSG
- 2.2 RPv per HSG (in.)
- 2.3 Target RCN per HSG
- 2.4 Target Runoff per HSG (in.)

0.00	75.97	0.00	83.48
0.00	1.13	0.00	1.48
0.00	65.03	0.00	83.50
0.00	0.76	0.00	1.48

- 2.5 Subarea LOD (ac)
- 2.6 Subarea Weighted RCN
- 2.7 Subarea Weighted RPv (in.)
- 2.8 Subarea Weighted Target Runoff (in.)

24.29
81.96
1.41
1.33

Step 3 - Upstream LOD Areas (from previous DURMM Report as applicable)

- 3.1 Upstream Sub-Area ID
- 3.2 Upstream Contributing Area (ac)
- 3.3 Target Runoff for Upstream Area (in.)
- 3.4 Adjusted CN after all reductions
- 3.5 Adjusted RPv (in.)
- 3.6 Adjusted Cv (in.)
- 3.7 Adjusted Fv (in.)

Area 1	Area 2	Area 3	Area 4

Step 4 - RPv Calculations for Combined LOD

- 4.1 Combined LOD (ac)
- 4.2 Weighted RCN
- 4.3 Weighted RPv (in.)
- 4.4 Weighted Target Runoff (in.)
- 4.5 Estimated Annual Runoff (in.)
- 4.6 Req'd Runoff to be Managed within LOD (in.)
- 4.7 Req'd Runoff to be Managed within LOD (%)

24.29
81.96
1.41
1.33
19.94
0.08
5%

PROJECT:	T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID:	BMP No. 4XX
LOCATION (County):	New Castle
UNIT HYDROGRAPH:	STD

**OUTSIDE LIMIT OF DISTURBANCE
(OLOD) WORKSHEET**

Step 1 - Site Data

1.1 Total Contributing Area (ac)	39
1.2 C.A. RCN	78
1.3 LOD Area (ac)	24.29
1.4 LOD RCN	82
1.5 Outside LOD Area (ac)	14.71
1.6 Outside LOD RCN	72

Step 2 - Time of Concentration

	2.1 LENGTH (feet)	2.2 SLOPE (ft./ft.)	2.3 SURFACE CODE	2.4 MANNINGS "n"	2.5 VELOCITY (ft./sec.)	2.6 TRAVEL TIME (hrs)
FLOW TYPE						
<i>Sheet</i>				-----	N/A	0.00
				-----	N/A	0.00
				-----	N/A	0.00
<i>Shallow Concentrated</i>				N/A	-----	0.00
				N/A	-----	0.00
				N/A	-----	0.00
<i>Open Channel</i>			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
			N/A			0.00
2.7 Time of Concentration (Tc)						0.10

Sheet Flow Surface Codes

a smooth surface	f grass, dense
b fallow (no residue)	g grass, bermuda
c cultivated < 20% Res.	h woods, light
d cultivated > 20% Res.	i woods, dense
e grass - range, short	j range, natural

Shallow Concentrated Surface Codes

u unpaved surface
p paved surface

Step 3 - Peak Discharge

3.1 Unit Hydrograph Type	STD	
3.2 Frequency (yr)	10	100
3.3 24-HR Rainfall, P (in.)	4.8	8
3.4 Initial Abstraction, Ia (in.)	0.778	0.778
3.5 Ia/P ratio	0.16	0.10
3.6 Unit Peak Discharge, qu (csm/in)	1044	1001
3.7 Runoff (in.)	2.08	4.75
3.8 Peak Discharge, qp (cfs)	49.97	109.32
3.9 Equiv. unit peak discharge (cfs/ac)	3.40	7.43

PROJECT: T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID: BMP No. 4XX
LOCATION (County): New Castle

RESOURCE PROTECTION EVENT (RPv) WORKSHEET

Step 1 - Calculate Initial RPv

- 1.1 Total contributing area to BMP (ac)
- 1.2 Initial RCN
- 1.3 RPv for Contributing Area (in.)
- 1.4 Req'd RPv to be Managed for Contributing Area (in.)
- 1.5 Req'd RPv to be Managed for Contributing Area (%)

BMP 1		BMP 2		BMP 3		BMP 4		BMP 5	
Type	13-B Wet Extended Detention (ED) Pond	Type	--	Type	--	Type	--	Type	--
Data									
39.00									
78.39									
1.23									
0.05									
4%									

Step 2 - Adjust for Retention Reduction

- 2.1 Retention volume provided (cu. ft.)
- 2.2 Retention reduction allowance (%)
- 2.3 Retention reduction volume (ac-ft)
- 2.4 Retention reduction volume (in.)
- 2.5 Runoff volume after retention reduction (in.)
- 2.6 Adjusted CN*

0%		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
1.23		N/A		N/A		N/A		N/A	
78.39		N/A		N/A		N/A		N/A	

Step 3 - Adjust for Annual Runoff Reduction

- 3.1 Annual CN (ACN)
- 3.2 Annual runoff (in.)
- 3.3 Proportion A/B soils in BMP footprint (%)
- 3.4 Annual runoff reduction allowance (%)
- 3.5 Annual runoff after reduction (in.)
- 3.6 Adjusted ACN
- 3.7 Annual Runoff Reduction Allowance for RPv (in.)

78.39		N/A		N/A		N/A		N/A	
17.06		N/A		N/A		N/A		N/A	
0%		0%		0%		0%		0%	
0%		N/A		N/A		N/A		N/A	
17.06		N/A		N/A		N/A		N/A	
78.39		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	

Step 4 - Calculate RPv with BMP Reductions

- 4.1 RPv Runoff Manangement Provided (cu. ft.)
- 4.2 RPv runoff volume after all reductions (in.)
- 4.3 RPv runoff volume after all reductions (cu.ft.)
- 4.4 Total RPv runoff reduction (in.)
- 4.5 Total RPv runoff reduction (%)
- 4.6 Adjusted CN after all reductions*
- 4.7 Adjusted equivalent annual runoff (in.)
- 4.8 RPv Compliance Met Through Runoff Reduction?
- 4.9 Runoff Reduction Credit, if Applicable (cu.ft)

0		N/A		N/A		N/A		N/A	
1.23		N/A		N/A		N/A		N/A	
174,703		N/A		N/A		N/A		N/A	
0.00		N/A		N/A		N/A		N/A	
0%		N/A		N/A		N/A		N/A	
78.39		N/A		N/A		N/A		N/A	
17.06		N/A		N/A		N/A		N/A	
NO		N/A		N/A		N/A		N/A	
N/A		N/A		N/A		N/A		N/A	

Step 5 - Determine Residual Volume to be Managed or Offset

- 5.1 RPv Residual Volume (in.)
- 5.2 RPv Residual Volume (cu.ft./ac)
- 5.3 Residual Volume to be Managed or Offset (cu.ft.)
- 5.4 RPv avg. discharge rate for 48-hr detention (cfs)
- 5.5 RPv max. discharge rate for 48-hr detention (cfs)

0.05		N/A		N/A		N/A		N/A	
171		N/A		N/A		N/A		N/A	
6,654		N/A		N/A		N/A		N/A	
0.039		N/A		N/A		N/A		N/A	
0.193		N/A		N/A		N/A		N/A	

*NOTE: No additional runoff reduction credit can be taken for surface recharge practices once the "Adjusted CN after all reductions" (Step 4.6) reaches the equivalent CN for the native soil-cover condition of the BMP footprint itself (i.e. for Sheet Flow to Turf Filter Strip on B soils Step 4.6 cannot be below 61). If this occurs contact the DNREC – SSP for further guidance

PROJECT:	T201609002 I-95 and SR 896 Interchange
DRAINAGE SUBAREA ID:	BMP No. 4XX
TMDL WATERSHED:	Christina River

TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET

Step 1 - Calculate Annual Runoff Volume

- 1.1 Total contributing area to BMP (ac)
- 1.2 Initial RCN
- 1.3 Annual runoff volume (in.)
- 1.4 Annual runoff volume (liters)

BMP 1				BMP 2				BMP 3				BMP 4				BMP 5			
Type:	13-B Wet Extended Detention (ED) Pond			Type:	--			Type:	--			Type:	--			Type:	--		
Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS	Data	TN	TP	TSS
39.00																			
78																			
17.06																			
6.84E+07																			

Step 2 - Calculate Annual Pollutant Load

- 2.1 EMC (mg/L)
- 2.2 Load (mg/yr)
- 2.3 Stormwater Load (lb/ ac/yr)

	2.80	0.49	90		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	1.91E+08	3.35E+07	6.15E+09		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	10.82	1.89	347.93		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A

Step 3 - Adjust for Pollutant Reduction

- 3.1 BMP annual runoff reduction (%)
- 3.2 Adjusted annual runoff volume (in)
- 3.3 Adjusted annual runoff volume (liters)
- 3.4 Adjusted load from annual reductions (lb/ac/yr)
- 3.5 BMP removal efficiency (%)
- 3.6 BMP effluent concentration (mg/L)
- 3.7 Final Adjusted load (lb/ ac/yr)

0%				N/A				N/A				N/A				N/A			
17.06				N/A				N/A				N/A				N/A			
6.84E+07				N/A				N/A				N/A				N/A			
	10.82	1.89	347.93		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	30%	55%	60%		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	1.96	0.22	36.00		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	7.58	0.85	139.17		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A

Step 4 - Pollutant Reduction Met? (For Informational Purposes)

- 4.1 TMDL (lb/ac/yr)
- 4.2 Reduction met?
- 4.3 Final Adjusted Load (lb/yr)

	5.70	0.35	N/A																
	NO	NO	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A
	295.51	33.24	5428		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A		N/A	N/A	N/A

PROJECT:	T201609002 I-95 and SR 896 Interchange		
DRAINAGE SUBAREA ID:	BMP No. 4XX		
COUNTY:	New Castle	UNIT HYDROGRAPH:	STD
TMDL Watershed:	Christina River	LANDUSE:	#REF!

DURMM OUTPUT WORKSHEET

DURMM v2.51.190603

Site Data

Contributing Area to BMPs (ac.)	39.00				
C.A. RCN	78.39				
Subarea LOD (ac.)	24.29				
Subarea RCN	81.96				
Upstream Subarea ID	N/A	N/A	N/A	N/A	
Upstream Subarea LOD (ac.)	0.00	0.00	0.00	0.00	
Combined LOD with Upstream Areas (ac.)	24.29				
Combined RCN with Upstream Areas (ac.)	81.96				
Watershed TMDL-TN (lb/ac/yr)	5.70				
Watershed TMDL-TP (lb/ac/yr)	0.35				
Watershed TMDL-TSS (lb/ac/yr)	N/A				

BMP Data

BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
13-B Wet Extended Detention (ED) Pond	--	--	--	--
RPv runoff volume after all reductions (in.)	N/A	N/A	N/A	N/A
Total RPv runoff reduction (in.)	0.00	N/A	N/A	N/A
Total RPv runoff reduction (%)	0%	N/A	N/A	N/A
RPv Compliance Met Through Runoff Reduction?	NO	N/A	N/A	N/A
RPv Residual Volume (cu. ft.)	6,654	N/A	N/A	N/A
Adjusted pollutant load, TN (lb/ac/yr)	7.58	N/A	N/A	N/A
Adjusted pollutant load, TP (lb/ac/yr)	0.85	N/A	N/A	N/A
Adjusted pollutant load, TSS (lb/ac/yr)	139.17	N/A	N/A	N/A
Cv runoff volume after all reductions (in.)	2.58	N/A	N/A	N/A
Fv runoff volume after all reductions (in.)	5.44	N/A	N/A	N/A

Resource Protection Event (RPV)

RPv for Contributing Area (in.)	1.23	
Annual Runoff for Contributing Area (in.)	17.06	
Req'd RPv to be Managed for Contributing Area (in.)	0.05	
Req'd RPv to be Managed for Contributing Area (%)	4%	
RPv Runoff Management Required (cu. Ft.)	6654	
RPv Runoff Management Provided (cu. Ft.)	0	
RPv Residual Volume (cu.ft.)	6654	SHORTFALL (Requires additional management or offset)
C.A. RPv avg. discharge rate (cfs)	0.04	
C.A. RPv max. discharge rate (cfs)	0.19	
TN Pollutant Load (lb/yr)	295.51	
TP Pollutant Load (lb/yr)	33.24	
TSS Pollutant Load (lb/yr)	5428	

Conveyance Event (Cv)

Cv runoff volume (in.)	2.58
Adjusted RCN for H&H Modeling (CN*)	78.39

Flooding Event (Fv)

Fv runoff volume (in.)	5.44
Equivalent RCN for H&H Modeling (CN*)	78.39

Adjusted Subarea Data for Downstream DURMM Modeling

Subarea ID	BMP No. 4XX
Contributing Area (ac.)	39.00
Weighted Target Runoff (in.)	1.33
Adjusted CN after all reductions	78.39
Adjusted RPv (in.)	1.23
Adjusted Cv (in.)	2.58
Adjusted Fv (in.)	5.44

Adjusted Subarea Data for Nutrient Protocol Modeling

Contributing Area (ac.)	39.00
LOD Area (ac.)	24.29
TN Pollutant Load (lb/yr)	295.51
TP Pollutant Load (lb/yr)	33.24
TSS Pollutant Load (lb/yr)	5428
Percent Impervious Cover	24%

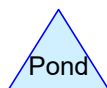
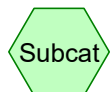
Adjusted Subarea Data for the Summary Table for Sub-Areas Draining to a Common Point of Interest

Subarea ID	BMP No. 4XX	
Contributing Area (ac.)	39.00	
RPv Residual Volume (cu.ft.)	6654	SHORTFALL (Requires additional management or offset)
Adjusted CN after all reductions	78.39	
Cv RCN for H&H Modeling	78.39	
Fv RCN for H&H Modeling	78.39	
TN Pollutant Load (lb/yr)	295.51	
TP Pollutant Load (lb/yr)	33.24	
TSS Pollutant Load (lb/yr)	5428	



DA to BMP No. 4XX

BMP No. 4XX



CONCEPT DESIGN

Drainage Diagram for I95&SR896 Preliminary SWM

Prepared by CEI, Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

I95&SR896 Preliminary SWM*Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05*

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 2

Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment4S: DA to BMP No. 4XX Runoff Area=39.000 ac 28.08% Impervious Runoff Depth=1.22"
Flow Length=2,911' Tc=28.0 min CN=78 Runoff=41.03 cfs 3.956 af

Pond 4P: BMP No. 4XX Peak Elev=68.19' Storage=239,569 cf Inflow=41.03 cfs 3.956 af
Outflow=0.19 cfs 1.030 af

Total Runoff Area = 39.000 ac Runoff Volume = 3.956 af Average Runoff Depth = 1.22"
71.92% Pervious = 28.050 ac 28.08% Impervious = 10.950 ac

I95&SR896 Preliminary SWM

Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 3

Summary for Subcatchment 4S: DA to BMP No. 4XX

Runoff = 41.03 cfs @ 12.23 hrs, Volume= 3.956 af, Depth= 1.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

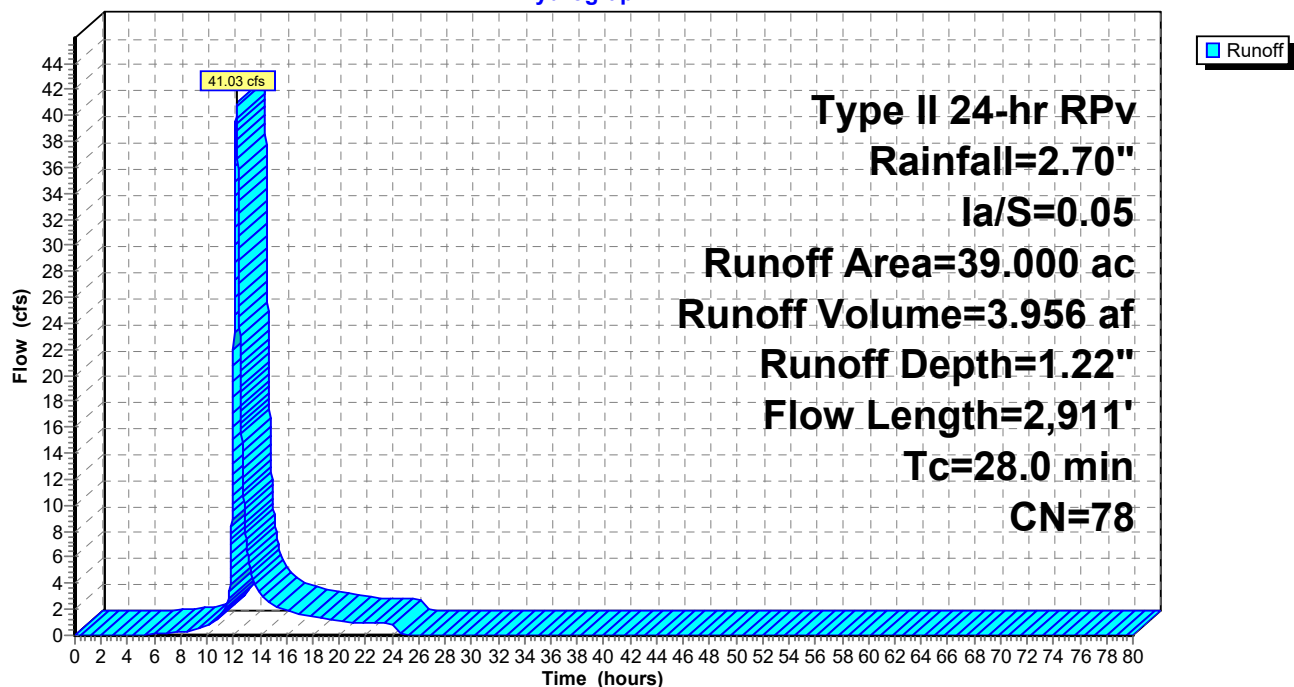
Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05

Area (ac)	CN	Description
7.520	55	Woods, Good, HSG B
2.990	77	Woods, Good, HSG D
3.560	98	Paved roads w/curbs & sewers, HSG B
7.390	98	Paved roads w/curbs & sewers, HSG D
3.320	61	>75% Grass cover, Good, HSG B
14.220	80	>75% Grass cover, Good, HSG D
39.000	78	Weighted Average
28.050		71.92% Pervious Area
10.950		28.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0907	0.14		Sheet Flow, Sheet Flow Woods: Light underbrush n= 0.400 P2= 3.30"
10.2	1,059	0.1199	1.73		Shallow Concentrated Flow, Shallow Woodland Kv= 5.0 fps
0.9	540	0.0873	10.16	455.38	Channel Flow, Side Ditch Area= 44.8 sf Perim= 77.4' r= 0.58' n= 0.030 Earth, grassed & winding
1.5	363	0.0420	4.00	7.50	Trap/Vee/Rect Channel Flow, Channel Bot.W=0.00' D=0.50' Z= 10.0 & 5.0 ' Top.W=7.50' n= 0.030 Earth, grassed & winding
0.1	70	0.0080	8.10	39.74	Pipe Channel, Pipe 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
0.1	40	0.0100	9.05	44.44	Pipe Channel, Pipe 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
1.6	216	0.0140	2.30	3.46	Trap/Vee/Rect Channel Flow, Channel Bot.W=0.00' D=0.50' Z= 7.0 & 5.0 ' Top.W=6.00' n= 0.030 Earth, grassed & winding
0.1	107	0.0174	11.94	58.61	Pipe Channel, 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
1.7	238	0.0147	2.34	2.34	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=0.50' Z= 4.0 ' Top.W=4.00' n= 0.030 Earth, grassed & winding
0.2	178	0.0152	12.60	89.08	Pipe Channel, 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.012 Concrete pipe, finished
28.0	2,911	Total			

Subcatchment 4S: DA to BMP No. 4XX

Hydrograph



I95&SR896 Preliminary SWM

Prepared by CEI

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Type II 24-hr R_{Pv} Rainfall=2.70", I_a/S=0.05

Printed 2/10/2020

Page 5

Hydrograph for Subcatchment 4S: DA to BMP No. 4XX

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	52.00	2.70	1.22	0.00
1.00	0.03	0.00	0.00	53.00	2.70	1.22	0.00
2.00	0.06	0.00	0.00	54.00	2.70	1.22	0.00
3.00	0.09	0.00	0.00	55.00	2.70	1.22	0.00
4.00	0.13	0.00	0.00	56.00	2.70	1.22	0.00
5.00	0.17	0.00	0.01	57.00	2.70	1.22	0.00
6.00	0.22	0.00	0.07	58.00	2.70	1.22	0.00
7.00	0.27	0.01	0.14	59.00	2.70	1.22	0.00
8.00	0.32	0.01	0.23	60.00	2.70	1.22	0.00
9.00	0.40	0.02	0.41	61.00	2.70	1.22	0.00
10.00	0.49	0.04	0.67	62.00	2.70	1.22	0.00
11.00	0.63	0.07	1.44	63.00	2.70	1.22	0.00
12.00	1.79	0.61	19.51	64.00	2.70	1.22	0.00
13.00	2.08	0.79	6.97	65.00	2.70	1.22	0.00
14.00	2.21	0.88	3.24	66.00	2.70	1.22	0.00
15.00	2.30	0.94	2.37	67.00	2.70	1.22	0.00
16.00	2.38	0.99	1.89	68.00	2.70	1.22	0.00
17.00	2.43	1.03	1.59	69.00	2.70	1.22	0.00
18.00	2.49	1.07	1.42	70.00	2.70	1.22	0.00
19.00	2.53	1.10	1.24	71.00	2.70	1.22	0.00
20.00	2.57	1.12	1.06	72.00	2.70	1.22	0.00
21.00	2.60	1.15	0.96	73.00	2.70	1.22	0.00
22.00	2.64	1.17	0.93	74.00	2.70	1.22	0.00
23.00	2.67	1.20	0.90	75.00	2.70	1.22	0.00
24.00	2.70	1.22	0.86	76.00	2.70	1.22	0.00
25.00	2.70	1.22	0.02	77.00	2.70	1.22	0.00
26.00	2.70	1.22	0.00	78.00	2.70	1.22	0.00
27.00	2.70	1.22	0.00	79.00	2.70	1.22	0.00
28.00	2.70	1.22	0.00	80.00	2.70	1.22	0.00
29.00	2.70	1.22	0.00				
30.00	2.70	1.22	0.00				
31.00	2.70	1.22	0.00				
32.00	2.70	1.22	0.00				
33.00	2.70	1.22	0.00				
34.00	2.70	1.22	0.00				
35.00	2.70	1.22	0.00				
36.00	2.70	1.22	0.00				
37.00	2.70	1.22	0.00				
38.00	2.70	1.22	0.00				
39.00	2.70	1.22	0.00				
40.00	2.70	1.22	0.00				
41.00	2.70	1.22	0.00				
42.00	2.70	1.22	0.00				
43.00	2.70	1.22	0.00				
44.00	2.70	1.22	0.00				
45.00	2.70	1.22	0.00				
46.00	2.70	1.22	0.00				
47.00	2.70	1.22	0.00				
48.00	2.70	1.22	0.00				
49.00	2.70	1.22	0.00				
50.00	2.70	1.22	0.00				
51.00	2.70	1.22	0.00				

I95&SR896 Preliminary SWM

Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 6

Summary for Pond 4P: BMP No. 4XX

Inflow Area = 39.000 ac, 28.08% Impervious, Inflow Depth = 1.22" for RPv event
 Inflow = 41.03 cfs @ 12.23 hrs, Volume= 3.956 af
 Outflow = 0.19 cfs @ 24.55 hrs, Volume= 1.030 af, Atten= 100%, Lag= 739.4 min
 Primary = 0.19 cfs @ 24.55 hrs, Volume= 1.030 af

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
 Starting Elev= 63.00' Surf.Area= 26,375 sf Storage= 75,784 cf
 Peak Elev= 68.19' @ 24.55 hrs Surf.Area= 36,953 sf Storage= 239,569 cf (163,785 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= 1,886.5 min (2,728.3 - 841.7)

Volume	Invert	Avail.Storage	Storage Description
#1	59.00'	453,967 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
59.00	14,577	0	0
60.00	16,015	15,296	15,296
61.00	17,517	16,766	32,062
62.00	19,084	18,301	50,363
62.01	24,540	218	50,581
63.00	26,375	25,203	75,784
64.00	28,299	27,337	103,121
65.00	30,260	29,280	132,400
66.00	32,279	31,270	163,670
67.00	34,375	33,327	196,997
68.00	36,522	35,449	232,445
69.00	38,746	37,634	270,079
70.00	49,206	43,976	314,055
70.01	66,197	577	314,632
71.00	69,154	66,999	381,631
72.00	75,519	72,337	453,967

Device	Routing	Invert	Outlet Devices
#1	Primary	63.00'	36.0" Round Culvert L= 186.2' RCP, groove end projecting, Ke= 0.200 Outlet Invert= 62.44' S= 0.0030 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished
#2	Device 1	63.00'	1.8" Vert. Orifice/Grate C= 0.600
#3	Device 1	68.50'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Head (feet) 0.00 2.50 Width (feet) 5.00 5.00
#4	Device 1	71.00'	66.0" x 30.0" Horiz. Grate C= 0.600

I95&SR896 Preliminary SWM

Prepared by CEI

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05

Printed 2/10/2020

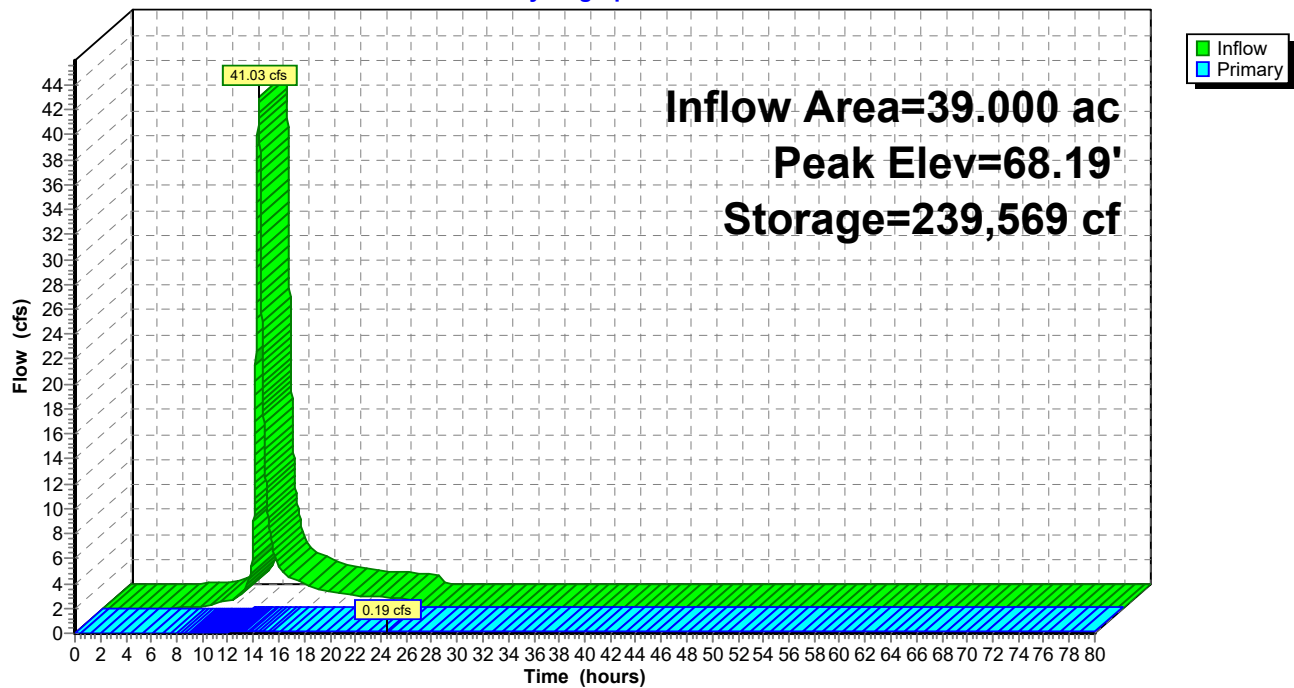
Page 7

Primary OutFlow Max=0.19 cfs @ 24.55 hrs HW=68.19' (Free Discharge)

- 1=Culvert (Passes 0.19 cfs of 61.38 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.19 cfs @ 10.89 fps)
- 3=Custom Weir/Orifice (Controls 0.00 cfs)
- 4=Grate (Controls 0.00 cfs)

Pond 4P: BMP No. 4XX

Hydrograph



I95&SR896 Preliminary SWM*Type II 24-hr RPv Rainfall=2.70", Ia/S=0.05*

Prepared by CEI

Printed 2/10/2020

HydroCAD® 9.00 s/n 06730 © 2009 HydroCAD Software Solutions LLC

Page 8

Hydrograph for Pond 4P: BMP No. 4XX

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	75,784	63.00	0.00
2.00	0.00	75,784	63.00	0.00
4.00	0.00	75,784	63.00	0.00
6.00	0.07	75,934	63.01	0.00
8.00	0.23	76,964	63.04	0.00
10.00	0.67	79,924	63.16	0.02
12.00	19.51	98,098	63.82	0.07
14.00	3.24	193,994	66.91	0.17
16.00	1.89	210,156	67.38	0.18
18.00	1.42	220,422	67.67	0.18
20.00	1.06	228,024	67.88	0.19
22.00	0.93	233,668	68.03	0.19
24.00	0.86	238,748	68.17	0.19
26.00	0.00	238,697	68.17	0.19
28.00	0.00	237,317	68.13	0.19
30.00	0.00	235,941	68.10	0.19
32.00	0.00	234,571	68.06	0.19
34.00	0.00	233,206	68.02	0.19
36.00	0.00	231,846	67.98	0.19
38.00	0.00	230,492	67.95	0.19
40.00	0.00	229,142	67.91	0.19
42.00	0.00	227,798	67.87	0.19
44.00	0.00	226,459	67.84	0.19
46.00	0.00	225,125	67.80	0.18
48.00	0.00	223,796	67.76	0.18
50.00	0.00	222,472	67.72	0.18
52.00	0.00	221,154	67.69	0.18
54.00	0.00	219,841	67.65	0.18
56.00	0.00	218,533	67.61	0.18
58.00	0.00	217,230	67.58	0.18
60.00	0.00	215,933	67.54	0.18
62.00	0.00	214,641	67.51	0.18
64.00	0.00	213,354	67.47	0.18
66.00	0.00	212,072	67.43	0.18
68.00	0.00	210,796	67.40	0.18
70.00	0.00	209,525	67.36	0.18
72.00	0.00	208,260	67.32	0.18
74.00	0.00	207,000	67.29	0.17
76.00	0.00	205,745	67.25	0.17
78.00	0.00	204,495	67.22	0.17
80.00	0.00	203,251	67.18	0.17